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ARE WE DRYING UP?

BY PROF. J. D. WHITNEY.

THE object of the present communication is to bring together some of the more striking facts in regard to the desiccation of the earth's surface, — or at least of a considerable portion of it, — which has taken place in the most recent geological period, and to suggest the inquiry, whether we have any proof that this desiccation has been and is continued into the historical period: in short, Are we drying up?

All questions relating to changes, or supposed changes, of climate during the historical period are of the greatest possible interest. Much has been written on this subject, and yet but little has been definitely established. There is a prevailing popular impression that the countries around the Mediterranean are drier than they were two or three thousand years ago, and that this change is due in part, if not wholly, to the cutting down of the forests which are assumed to have once existed there. Yet, when this matter comes to be investigated, it would appear that there is little if any evidence either that there has been any such wholesale stripping of the wooded lands, or that there has been any considerable change in the climate of that region. The question of the influences of forests on the amount of the rainfall has been ably and carefully examined by Mr. G. P. Marsh, and his results are thus summed up: "The scientific reputation of many writers who have maintained that precipitation has been diminished in particular localities by the destruction of the forests or augmented by planting them, has led the public to suppose that these assertions rested on sufficient proof. We cannot affirm that in none of these cases did such proof exist, but I am not aware that it has ever been produced." [1] It ap-

[1] The Earth as Modified by Human Action. New York, 1874. Page 196.

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pears to be true, at all events, that exact observations with the rain-gauge have not yet anywhere been kept up for a sufficient time to enable us to speak with certainty with regard to the existence of any secular change in the amount of rain falling at any one place. The length of time during which such observations have been made is but trifling compared with the duration of the historical period, and infinitesimally small when considered with reference to even the most recent of the geological epochs.

We have, however, as will be seen, abundant evidence of a great change over at least a considerable part of the earth's surface, in the amount of water distributed in the lakes or running in the rivers, and it can be shown, beyond a doubt, that this change has been taking place within a very recent period, speaking geologically. Some important evidence can also be adduced to the effect that this change has been continued in the historical epoch, although not yet capable of demonstration by the recorded observations of the rain-gauge.

There are two regions especially where the facts already collected show most clearly, not only a diminution in the amount of water existing on the surface, but a most striking one. In Central Asia and in Western North America, the observations of numerous observers all point unmistakably in this direction. The observations of the Schlagintweits in Thibet and Turkistan may first be mentioned. One or two extracts may be given from H. von Schlagintweit's article entitled, "Investigations on the Salt Lakes in Western Thibet and Turkistan."[1] He writes as follows: "In all portions of High Asia, south and north of the main water-shed, there are numerous places where the former existence of mountain lakes may be recognized." . . . "In Thibet, throughout the entire longitudinal depression between the chain of the Himalaya and the main water-shed of the Karakorum, of the once numerous lakes, but comparatively few are still in existence." . . . "So extreme is the dryness in Western Thibet that, in the case of nearly all the lakes still remaining, the evaporation exceeds the supply of water, so that the prevailing condition is at the present time one of gradual diminution in the area covered by water." There seems to be here, in combining all the results of the Messrs. Schlagintweits' observations, abundant evidence of a marked change of climate in the most

[1] From the Proceedings of the Bavarian Academy of Sciences, Cl. II. Band xi. Abth. 1.

recent geological period, — resulting in the almost entire disappearance of extensive lakes, — and also that this desiccation is still going on.

The observations of Mr. Drew, the author of an elaborate work on the Jummoo and Kashmir territories,[1] fully corroborates the often previously expressed opinion, that the Valley of Kashmir was, in later geological times, completely occupied by a lake. But no evidence has, as yet, been discovered to prove that this desiccation took place during the historical period, although the traditions of the natives point in that direction. There is, however, abundant proof of diminution in the area covered by water in the basin of the Aral and Caspian seas, not only during the latest geological epoch, but also within a comparatively recent period. Those who wish to investigate the matter will find the material in a paper by Major Wood, published in the journal of the Royal Geographical Society for 1875. There is no doubt of the former vastly greater extension of the Caspian and Aral seas. While there has been much discussion with regard to the shifting of the channels of the rivers entering these seas, and their variations of height at various times during the historic period, it seems beyond dispute that a gradual desiccation of the region has been in progress, and that it is still going on. That there once existed here a vast Asiatic Mediterranean which connected by navigable waters with the Northern Ocean is very generally admitted. With reference to the diminution in the water of Lake Aral at present going on, Major Wood says:[2] "The sand-drives and tracts of hard clay occurring on the low shores of Lake Aral point to the conclusion that extensive areas of country which are now dry land were formerly covered by the water-spread of the lake. It has been remarked that the mouth of the Syr-Daria has become in recent years fordable, and that the depth of water between the island of Tokmak Atta and the south shore of Lake Aral has diminished. It is also an established fact that a minaret, which gray-beards of the Kirghiz state was formerly situated on the edge of the eastern shore, is now at some hours' walk distant from it; and finally, since 1848, when it was a marshy swamp, Gulf Abougir, at the southwest corner of the Lake, has been entirely dried up, and its bed is now under cultivation. There is no doubt that the cause of this continuous

[1] The Jummoo and Kashmir Territories. A Geographical Account. By Frederic Drew, F. R. G. S., F. G. S., London. 1875.

[2] Journal of the Royal Geographical Society, vol. xlv. page 403.

shrinking in the area of Lake Aral is that the evaporation from its surface is in excess of the supply received by it from the Amu and from the Syr."

Similar facts in regard to the diminished quantity of water in Arabia are cited by various travelers in that country. Some of them are given in Mr. Marsh's volume, to which reference has already been made.

In Africa the existence of extensive ruins in the Great Libyan Desert, in a region quite destitute of water, and which is now entirely uninhabited, may be taken as a strong indication of great changes since the historic period. Dr. Livingstone, in his travels in southern Central Africa, was again and again much impressed with the proofs presented to him of a rapid and extensive diminution within recent times of the amount of water in the lakes and rivers of that region.[1]

But it is not only in the Old World but also within our own territory that a former much greater extension of the water system can be easily demonstrated. The terraced character of the rivers of our northeastern States afford ample proof that these once conveyed a much larger quantity of water than they now do. The facts have been set forth in detail by various geological writers, and especially in President Hitchcock's Surface Geology. It is true that geologists have only lately generally admitted the apparently self-evident fact that the origin of these terraces is due to a diminution in the quantity of water which the streams have conveyed, and not to any sinking or rising of the land.

It is, however, in the region west of the Rocky Mountains, especially in the "Great Basin," that we find a condition of things most strikingly resembling that already noticed as existing in Central Asia. Everywhere, throughout the area occupied by Utah and Nevada and portions at least of the adjacent territories, the evidences of desiccation within the most recent geological period are very striking. These facts were first brought to notice in part in the Geology of California, volume i. (1865), in which the terraces surrounding Mono Lake were described, and the former greater extension of this and the adjacent lakes shown to be beyond doubt. The same thing was also noticed and commented on in the Yosemite Book (1869). The terraces surrounding Great Salt Lake are so conspicuous that no traveler

[1] See Livingstone's Missionary Travels in South Africa. London. 1857. Page 528. He says: "All the African lakes hitherto discovered are shallow in consequence of their being the mere *residua* of very much larger ancient bodies of water."

passing through that region on the railroad could fail to notice them. The publication of the detailed maps of this region by the Fortieth Parallel Survey will, no doubt, furnish data for estimating with considerable precision how large an area was formerly covered with water, and how numerous and extensive the different bodies of water were.

It is not to be expected that in our western territories there should be any proof obtained of a diminution in the quantity of water having taken place during the historic period. The character of the aboriginal inhabitants and the perishable character of their dwellings forbid this. Yet there are traditions pointing in this direction, as noticed in the Geology of California, volume i., the mountaineers insisting on the former connection of Mono and Walker's Lakes. However this may be, it is certain that the sharp and well-defined character of the terraces in this region indicates very clearly that the diminution of the volume of the water must have been an extremely recent phenomenon.

It is not possible at this time to enter upon a discussion of the question of the connection of this desiccation with the so-called glacial phenomena. It has seemed natural, of course, for geologists to connect the terraced condition of the rivers in the northeastern States with the melting of the ice of the glacial period. As far as the problem at present under discussion is concerned, it makes no difference whether we do or do not consider the desiccation in question as one of the sequence of events to which the glaciation of a portion of the northern hemisphere belongs. What we are specially interested in is, whether the desiccation is still going on. If, as seems highly probable from what has been advanced in the previous pages, the quantity of water on the surface, over large areas, has considerably diminished, certainly in the very latest geological times, and also in part within the historic period, then it is not likely that the former glaciation and the present desiccation can be considered as so intimately connected in their general cause that the latter cannot take place except as a sequence of the former. The absence of any very distinct proof of a much greater extension at any time of the ice masses over the ranges of Central Asia must be taken into consideration in connection with the extensive and rapid drying up of what has been and is now going on in that region. The same may be said in reference to the Great Basin and our own western territory. At the time of the greatest extension of the glacial masses in that region, but an insignificant propor-

tion of the surface was thus covered. Only the very summits of the highest ranges had glaciers upon them, and the amount of snow and ice thus stored away would seem to have been far too small to produce by their melting a general filling of all the valleys with water unless we assume — which is certainly not probable — that the change was almost instantaneous.

It is certain that both in Asia and North America the phenomena of desiccation are on too grand a scale by far to be supposed to have anything to do with cutting down of forests. The drying up has been commenced before man interfered with nature, and has been continued without reference to his puny operations.

If, as has been suggested, the records of rain-gauge and thermometer are too incomplete and unsatisfactory to throw any light on the question of climatic changes of importance in modern times, the question arises whether there are not other sources of information to which recourse can be had. For instance, records have, in parts of Europe, been kept for many years of the flow of water in some of the principal rivers. Can any results be obtained from a comparison of these records with a view to the settlement of the question, whether the amount of water passing from year to year at certain points has diminished, increased, or remained constant? The eminent geographer, Berghaus, was one of the first to take up this investigation. He worked up the observations of the Rhine made at Emmerich, those of the Elbe at Magdeburg, and those of the Oder at Küstrin, and came to the conclusion that each of these rivers had decreased in volume during the past hundred years, and that there was reason to fear that they would eventually have to disappear from the list of the navigable streams of Germany. Later than this, an eminent hydraulic engineer, Gustav Wex, chief director of the important "Donauregulirung,"[1] and a high government official, undertook the same investigation, but with much more detail. His results, however, are similar in character to those of Berghaus, and seem to demonstrate beyond the possibility of doubt that the principal streams of Middle Europe, namely, the Danube, the Rhine, the Elbe, the Vistula, and the Oder, together draining an area of 570,000 square miles, have for many years been carrying a constantly diminishing quantity of water. The longest series of observations used in coming to this conclusion is that of the Elbe, at Magdeburg, where the records go back for one hundred and

[1] A great work undertaken with a view to the regulation and improvement of the channel of the Danube at and near Vienna.

forty-two years ; but the observations for shorter periods of from fifty to seventy years, which in the case of the other streams are all that are available, seem to leave no doubt as to the character of the result.

The probable causes of this diminution in the quantity of water in the Middle European streams are discussed at some length by Mr. Wex,[1] as also by a committee of the Vienna Academy of Sciences, appointed to report on his communication, and among whom were several eminent meteorologists. The general impression, both of Mr. Wex and the committee, seems to be that the cutting down of the forests is the essential cause of the desiccation. But the number of facts which can be given in support of this hypothesis is quite small. It is, as Mr. Marsh has stated, not so much facts as the general opinion on which reliance is placed in citing the destruction of the forests as the probable principal cause of the difficulty. It is easy to see that stripping the woods from the surface increases the rapidity of the evaporation, and that in consequence of this less water must flow in the streams unless the deficiency is made up by a larger precipitation. It is extremely difficult to prove anything in this connection in a region where so many small patches of forest are mixed up with the cleared land, as is the case in Germany. But it is fair to presume that the moisture taken up in one part of a great river basin must be let fall again in the form of rain somewhere within the limits of the same basin. Hence we should have no difficulty in understanding that stripping the surface of its trees would cause increased and irregular precipitation, which would have injurious and even disastrous effects in mountain regions, where the soil was thus laid bare to be washed away by torrential flows of the streams following on sudden and heavy falls of rain. That this is really the case is well known from experience in the Swiss and French Alps, and elsewhere. But that a positive diminution in the average quantity of water carried down in the streams would necessarily ensue on removing a portion of the forests in any region, we do not consider to have been proved as yet. The commission, in reporting on Mr. Wex's paper, are quite cautious in their expressions of opinion on this subject, showing their uncertainty by even taking into consideration the question whether the progressive hydratation of mineral substances consequent on the cooling down of the crust of the earth,

[1] This paper was published in the Zeitschrift des öst. Ingenieur and Architekten Vereins for 1873.

may not, as suggested first by Saemann and afterwards by Delesse, have something to do with the proven desiccation.

In regard to one question this commission of the Vienna Academy is quite unanimous, and this is that great pains should be taken by the different governments of the enlightened states throughout the world to obtain more light and additional data bearing on this subject. If desirable for Europe it is still more so in this country. We need much more numerous and more accurate observations of rain-fall. One cannot but be struck, in examining Mr. Schott's working over of the Smithsonian rain-tables, with the poverty and incompleteness of the data. We need also careful and long-continued measurements of the amount of water flowing in some of our principal rivers. For instance, New York should establish a systematic investigation of the Hudson River, and Massachusetts or Connecticut, or both, should take in hand the river which flows through those two States, and which is of so much importance to their manufacturing and other interests. For California, especially, these investigations are of the greatest importance. If it can be shown that the removal of the forests seriously diminishes the quantity of water running in the streams, then there is yet time to stay the hand of the wood-cutter ere the mischief be consummated. That the stripping of the Sierra Nevada of its timber would be essentially injurious to the State in increasing the already alarming irregularity of the seasons there can be little doubt, even if the average precipitation were to remain the same.

That there has been a very marked decrease in the amount of water on the earth within the most recent geological period is beyond a doubt; and that there is considerable reason to believe that the desiccation is still going on has, we think, been made evident in the above pages, although it has been necessary to handle with extreme brevity the various points advanced. Much might be said with reference to the connection of the so-called "glacial epoch" with the present one of desiccation, but this part of the discussion must be reserved for another occasion.

THE MODE IN WHICH COCKROACHES AND EARWIGS FOLD THEIR WINGS.

BY SAMUEL H. SCUDDER.

SEVERAL years ago, Dr. Henri de Saussure, of Geneva, published, under the title of Études sur l'Aile des Orthopteres,[1] some interesting observations on the structure of the wings of cockroaches. He treated particularly of the folding of the wings in those groups of Blattarians where the wing is very ample and some contrivance necessary to insure its complete protection by the smaller wing-covers. The necessity of some peculiar arrangement in the winged genera of earwigs, where the extended wing is often ten times larger than the wing-covers (tegmina) is even more evident; and to understand the nature of the structural modifications of a normal wing-type (which are here universal), it will be convenient and instructive to examine the cockroach's wing on the basis of Saussure's memoir, for in different genera of this group we have every stage of change from simple unreversed wings scarcely larger than the tegmina, to those of great size, curious complication, and unique mode of duplicature.

In the hind wings of all Orthoptera, the anal area, or the area traversed by the nervules of the posterior part of the wing, is unusually ample; the branches of the anal vein are numerous and straight, and originate not far apart nor far from the base of the wing; when the wing is fully expanded they diverge like the rays of a fan; and like a fan they fold themselves against the sides of the body, the membrane of the wing folding along an edge midway between each pair of rays; this admits of a large expansion of the anal field, and provided the wings are not quite so long as the tegmina, any breadth, folded close, may be covered by this coriaceous appendage. This, however, would not necessarily be true, if the anterior part of the wing, provided with stiff interlacing veins, were itself as broad as the tegmina; for then, if the front edges of the wings and tegmina were brought together, the entire folded anal area would extend beyond the opposite margin of the wing, quite unprotected by the tegmina; to obviate this, the line of separation between the anal area and the anterior part of the wing is itself an axis of duplicature, and the folded anal area always lies beneath the stiff anterior parts of the wing.

[1] Annales Sc. Nat. [5] Zool. x. 161–200, plate 11.

This is a mode of duplicature common to all groups of Orthoptera. But we have in cockroaches and earwigs something superadded, where the wing is large, and folded not only longitudinally but transversely, and is ingeniously packed away beneath the shorter tegmina. We will follow Saussure in tracing among the cockroaches the various steps from the simple to the complex form.

As usual among insects, the anal field of the hind wing in cockroaches (Figure 29, *r* [1]) does not generally extend much more than half way toward the tip of the wing; and, as in most insects, especially those of low organization, the upper limit of this area (that separating it from the principal part of the wing, Figure 29, *p*) is marked at the edge of the wing by a slight emargination. The first step toward the result to be attained is the lengthening of the anal field so that it equals the anterior parts, bringing the indentation to the apex of the wing. This is seen in *Thorax porcellana* of the East Indies. There is, however, a little triangular bit of membrane left between this indentation and the lowermost nervule of the next vein above. It is to this little triangle that we must direct our attention. For in the next stage, such as is seen in a common European cockroach, *Ectobia lapponica*, this triangle has greatly enlarged; the principal longitudinal fold of the wing, that separating the anal area from the parts above, is obliged to run directly through the middle of this triangle, so that we may fairly consider one half as belonging to the anal and the other half to the median field of the wing. Since, however, it contains in itself no nervures and has become also of a more or less coriaceous texture, its posterior portion cannot take part in the plications of the anal field; moreover, it has expanded apically and now forms the entire tip of the wing, producing at its upper limit a slight excision of the edge similar to the normal emargination at its lower limit. When the anal field-fan is closed and lies at rest beneath the anterior part of the wing, this triangle, reduced to half its size by a single fold, lies beyond the edge of the wing, and either folds back again upon the upper surface of the wing or curls up in the same position and is thus

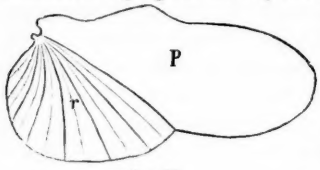

FIG. 29.

[1] Figures 29–40 have been generously forwarded by Dr. de Saussure for the illustration of this paper.

wholly concealed by the tegmina. When this triangle has enlarged still more, as in the East Indian *Prosoplecta coccinella* (Figure 30), the nervules on either side of it have been forced,

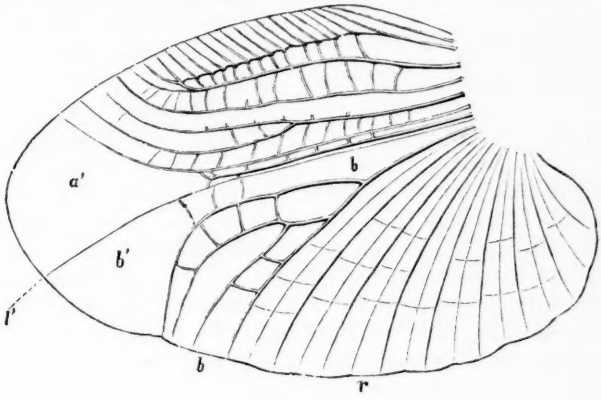

Fig. 30.

as it were, to curve upward or downward to give it room; those below the triangle have undergone a still more remarkable modification to which we shall again allude. In further steps this triangle expands still more (Figure 31, *Plectoptera porcellana* of

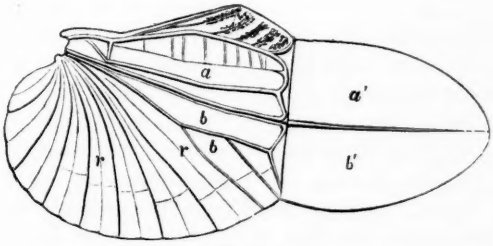

Fig. 31.

Cuba), throwing the veins on either side of it farther and farther back, until they fall into a single straight line at right angles to their former direction, one being turned upward, the other downward; and as this line marks the crease where in *Ectobia lapponica* the triangle was folded back upon the top of the wing, so now the wing, having first been folded longitudinally throughout its entire length (the hinder portion lying beneath the upper), has its tip folded over, not far beyond the middle, upon the upper surface of the wing.

It may here be worth while, by the aid of diagrams, to explain a little more carefully the mode in which the wings are folded. Figure 32 may represent a fully expanded wing, such as that last described; *ab*, *a'b'* (*p* of Figure 29) may be called the principal part of the wing, and *r* the diverging field; the bent longitudinal line, separating the anterior zone (*aa'*) from the reversible zone (*bb'*) is the principal longitudinal fold of the wing, to which we have constantly referred; the straight line separating the basal (veined) portion of the wing (*ab*) from the apical (coriaceous) reflectible portion (*a'b'*) is the transverse fold, which in the simpler wings is represented by the upper and lower margins of the apical triangle. The diverging field (*r*) first folds like a fan, so that *b* and *r* together are no broader than *a*; the wing then folds longitudinally, *bb'* bending downward beneath *aa'*, and presents the appearance seen in Figure 33, where *a* and *a'* are alone visible; *a'* now bends upward and folds back upon *a*, as in Figure 34, and the wing is reduced to a little pad, which scarcely surpasses the basal portion of the anterior zone *a*.

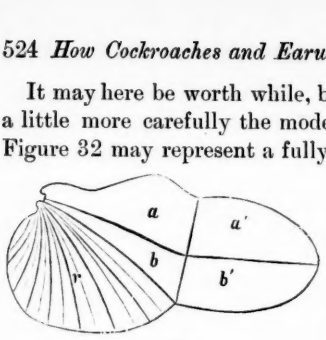

Fig. 32.

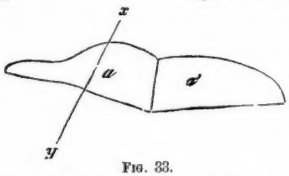

Fig. 33.

Figures 35 to 37, which represent a theoretical section of the wing along the line *xq* (Figure 33), will explain still further this mode of duplicature. In Figure 35 the wing is fully expanded, and *c* represents the costal, *z* the posterior border of the wing; *a*, *b* and *r* represent the same part as in Figure 32, *p* the longitudinal fold or plication separating the anterior from the reversible zone, and *g* the point of division between the reversible zone and the diverging field. In Figure 36 the first step is seen, namely, the result of the plication along the longitudinal fold *p*; Figure 37 (in which the letters bearing primes represent the same parts in the reflectible portion as the equivalent letters in the basal portion of the wing) carries the process to its completion. Figure 38 represents a horizontal section of the completely folded wing; *o* is the anterior, *o'* the posterior articulation of the wing; *o' v* represents the diverging field, *o' t'* the basal portion and *t' e'* the

Fig. 34.

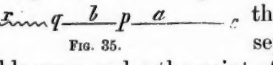

Fig. 35.

Fig. 36.

reflexible portion of the reversible zone; and *ot*, *te* the corresponding portions of the anterior zone.

There are further modifications of this duplicature; thus in some types, the anal field being ample, a simple fan-like closure of the anal area is not sufficient, and its whole mass is again folded longitudinally and lies not only beneath the under surface of the anterior part of the wing, but beneath the reversible zone or anterior part of the anal area. This may readily be seen on examining Figures 39 and 40 (cf. figures 36 and 37) in which the diverging field *r* or *qz* is bent upon *pq* and lies beneath all the other folds of the wing. Add to this the reversal of the tip of the wing, and by a single stroke of the knife, one may cut through five layers of membrane, not counting the fan-like plications of the anal area which might be severed.

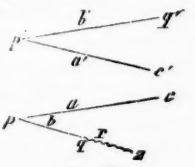

Fig. 37.

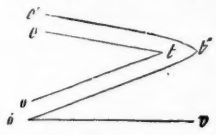

Fig. 38.

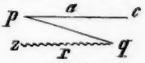

Fig. 39.

There is another curious fact; namely, that when the apical triangle has reached or nearly reached its maximum development, as in *Prosoplecta coccinella* (Figure 30) and *Plectoptera porcellana* (Figure 31), that portion of the anal field which lies within the transverse fold, and above a line drawn from the socket of the wing to a point near the anal emargination (*i. e.*, the basal portion of the reversible zone, *b*, *b*), assumes a venation precisely analogous to that of the upper half of the wing with all its distinct cross-veins and odd reticulations; this becomes possible because it is no longer folded with the rest of the anal field, and does not require simple longitudinal veins. When situated above the anal emargination its relation to the anal area is almost entirely disguised. Even further than this: in some types, as in the Australian *Diploptera silpha*, the terminal reversed area, a simple development of the apical triangle, is filled with a net-work of secondary veins, wholly similar to those of the parts toward the base, and in some instances (but for the transverse fold) direct continuations of them; were the steps unknown by which such a mode of wing-duplicature had been produced, and *Diploptera silpha* the sole living example of such duplicature, the structure of its wings would be utterly incomprehensible on

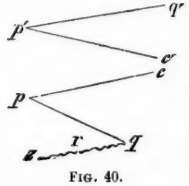

Fig. 40.

the hypothesis of any unity of type in the wing structure of insects.

But these later developments in the modification of the veins themselves have no bearing upon the structure of the wings of earwigs, and have only been introduced for their own interest and to complete the account we have given of duplicature in the wings of cockroaches. We may, however, keep the last statement before us when we recall the fact that the wings of all earwigs (so far as I have been able to determine after an examination of many types otherwise diverse) are identical in their general structure and wholly different from those of any other insects, having been extraordinarily modified to serve a special purpose.

In these insects the fore wings (tegmina) are always small and generally but little longer than broad, although earwigs are invariably slender, and the tegmina, to cover the abdomen, would need be very long. The wings, when folded, generally extend a little beyond the tegmina, and the parts which protrude are coriaceous and wholly devoid of veins; being moreover frequently ornamented with a colored spot or stripe, and thus further resembling the tegmina, they might be taken for a second pair of tegmina precisely like the first, or differing only in a slightly increased length; even if the tegmina are removed the deception remains, for the parts of the wings then exposed are coriaceous to the base. These wings, however, are quite as ample as those of other Orthoptera of equal size; but, by a complicated system of duplicature, accomplished by the mere elasticity of the parts, they are in a few seconds packed snugly beneath the pad-like tegmina, out of danger of abrasion or rupture, as the insect seeks the hidden recesses and crevices where it passes the larger part of its existence.

The most extraordinary thing about the structure of the wings is the immense extent of the anal area; not only does this reach from base to apex of the wing, as in the extreme type of cockroaches, but the entire wing, excepting only a portion about equalling the area of the tegmina, is made up of this field; the portion which does not belong to it is almost entirely coriaceous, so that nearly all the nervules of the wing belong to the anal vein. In the hind wings of Orthoptera in general, this anal vein may be roughly described as consisting of a basal arc to which the bases of the various rays are attached one beneath another; or, rather, the enlarged bases of these rays, lying one beneath

another, constitute the arc. This basal arc is closely attached to the lower articulation of the wing with the body in the other families of Orthoptera; but in the earwigs one of these veins, the second from the attachment (see Figure 41,[1] which represents

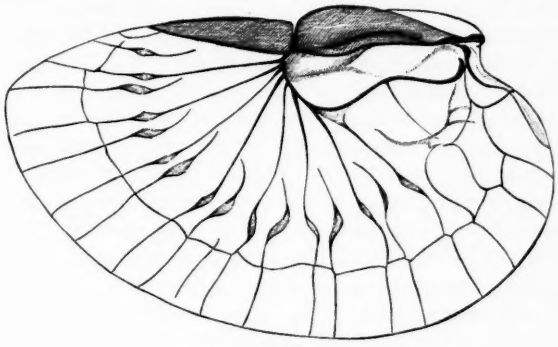

Fig. 41.

the wing of *Labidura riparia*, common in Europe and America) extends out nearly to the middle of the wing, emitting on the way one or two inferior branches; and, curving upward to the front border just beyond the coriaceous part of the wing (from which it is separated anteriorly by an incision), forms at this point, about the middle of the front border of the wing, the base for the attachment of the diverging rays, which sweep around the entire extent of the wing. The wing may then be said to have two bases; one the point of attachment of the whole structure to the body; the other, the pivot in mid-wing, around which the extensible major part of the wing plays. The radiating veins as well as the independent veins which arise between them, show a further peculiarity in having near the middle a considerable expansion, generally accompanied by an equivalent tenuity, so as to make the wing appear delicately coriaceous in a narrow circuit parallel to the outer border and about midway between it and the hinge or pivot in mid-wing. As to the other veins of the wing, their importance is too slight to be worthy of consideration in this connection; they occupy but a narrow area bordering the coriaceous base of the wing and are present only to an extent sufficient to indicate with certainty that it is the anal vein, to which the mass of nervules must be referred. The anomalous structure of the wing is at once seen on comparing it

[1] Which we owe to the kindness of Mr. Edward Burgess.

with the wing of a cockroach, its nearest ally, and the purport of the anomaly will appear when we examine carefully the closure of the wing.

Suppose this wing expanded to its utmost. It is retained in its place by muscles which act upon two sets of veins; an anterior set which supports the coriaceous base of the front part of the wing, giving a certain strength and solidity to the whole; and a posterior set which holds at arm's length, as it were, and therefore at great disadvantage, the body of the wing, hinging upon the extremity of the second anal branch which runs from base to mid-wing. Let the latter support be relaxed and the fan closes at once; the pivoting point is seen to be the very bottom of the incision of the wing next the apex of the coriaceous portion, an incision in the middle of the front border of the wing, corresponding to the anal emargination of the apex of the wings of certain cockroaches and to that of the middle of the hind border of most insects. When this fan of the anal field is closed, the plications are brought beneath that portion of the wing which lies between the extended vein which supports the rays and the lower edge of the coriaceous base of the wing. Since the coriaceous base does not extend quite to the middle of the expanded wing, the wing by this process is at once reduced to less than half its length; and the former apex for the same reason now overlaps the base and rests beside it against the body; the width of the wing being also reduced, the entire area is now less than one sixth its former extent. As the wing continues to close, the lower half, with its tightly plicated membrane, folds longitudinally beneath the coriaceous basal portion, so that the plications are completely encased, like leaves in a book, between a coriaceous upper layer and the thinner membrane of an equal portion of the wing lying, when the wing is expanded, directly behind it; the apex of the wing, however, now lies in even a worse position than before, directly beneath the root of the wing; or would do so, but having by this last movement been turned upside down, its elasticity allows another movement which its very position before prevented; and we now perceive the meaning of the expansion and tenuity of the radiating veins in points arranged in a circuit parallel to the outer border; on the folding of the wing these are brought together, and it is just here that the apex of the wing, which is apparently so much in the way, now bends transversely downward beneath the remainder of the wing, and the whole is reduced to less than a tenth, probably

less than a fifteenth, of its former extent. The anterior supports are now relaxed, the wing assumes its natural position, the wing-cover closes down upon it, and all is snugly packed away.

Although I have never experimented upon a living earwig, it will be apparent to any one who has attempted to expand a wing rendered flexible by artificial means, that the closure of the wing is produced by the mere elasticity of the parts. It is also altogether analogous to the process of duplicature in the cockroach, as carefully explained by Saussure, and it is difficult to explain the process in any other way. The mode in which they are opened would be much more difficult to understand if it had not been observed by Charpentier and described nearly forty years ago. The contraction of the extensor muscles attached to the hinder set of veins would undoubtedly cause the fan to expand when once the double folding, transverse and longitudinal, had been overcome; but it does not seem possible that they could cope with this difficulty. How then is it done? According to Charpentier, simply by means of the forceps with which the extremity of the abdomen is always provided in both sexes; the tip of the body is bent upward and the forceps used with great rapidity and ease, first on one side and then on the other, as a sort of fingers, to bring the wings into the position which would allow the action of the thoracic muscles upon the base of the principal veins. Nevertheless, it is difficult to conceive how this operation can be performed by those species whose forceps are as long as their body.

COOPER'S HELIX IN COLORADO.

BY E. A. BARBER.

AMONG the Helices, there is perhaps no species which presents greater diversity in form, size, and markings, than *Helix Cooperi*. Until recently, our knowledge has been somewhat limited in regard to this beautiful and interesting western species; but our information has been materially increased of late, by the results of the researches of the United States Geological Survey. During the summers of 1874–75, I found great quantities of these shells throughout Colorado, in a variety of locations, and under variable conditions. I first discovered them in Middle Park, a few miles from the Hot Sulphur Springs, or the settlement known as Grand City, on the head-waters of the Grand or Gunnison River. As we were riding along through a severe hail-

storm, we crossed over a hill which was literally covered with white objects, which I at first supposed to be hail-stones, but which I soon perceived were weather-worn shells of this species. Hastily dismounting, I scooped together, from a space scarcely two feet square, over a pint of them, which I carried back to camp for examination. They were so numerous that half a bushel could have been raked together without difficulty in a very short time, but they seemed to be confined to this particular elevated mound. All were dead, being in a dry, exposed situation, and but few of them were worth preserving. This was at an altitude of about 8500 feet, although I have found numbers of these shells just below the timber-line on the summits of mountains, 11,000 feet above tide water. Such specimens were usually more fully developed, although I never found them in a living state above 9500 feet. And here I may add that I have never discovered a single specimen on the eastern or Atlantic slope, and I have yet to see the first sample which was discovered there, although I do not assert that *H. Cooperi* does not occur on this side of the Range.

Along the banks of small streams and springs, in the damp sedge and grass, and in shaded spots, I found many, but rarely more than a dozen together. All of these latter were in a living state, and on extracting the animals from the shells, I found that they were viviparous, nearly every one containing about twenty-five minute, well-formed shells. In the cañons cleft in the mountain sides, among the dank underbrush, the most brilliantly colored specimens were obtained, each being marked with longitudinal or spiral bands of dark red or brown, varying in number from one to five, but usually two. In some instances the entire shells were dark, with the exception of a narrow, bright-colored band.

Through North Park they are abundant, and farther west, along the Bear (or Yampa), White, Grand, and Eagle (Piney Creek) Rivers. Near the South Branch of White River I discovered a locality, on the summit of a high hill, abounding in quantities of a larger variety of this species. The individuals were, some of them, as large as an average *Helix albolabris;* but all of these were empty, and bleached perfectly white. The shells were depressed, and thick and heavy. In the same neighborhood (as in fact, throughout the most of northwestern Colorado), bleached shells are scattered over the surface of the ground in such quantities that the traveler may pick up, almost anywhere, quarts of them. In particular places the soil is strewn so thickly

with them that one can scarcely walk without crushing several at every step. Where they occur so numerously the shells are invariably empty and bleached, and in all probability they have been lying in this condition for years. Through burned forests where every tree has been charred, and the underbrush entirely destroyed, they are to be seen, lying on the blackened ground, in even greater quantities than under any other condition. And this I accounted for in the following manner: At certain times of the year the animals bury themselves in the moist earth, and when the forests are fired by the Indians, the heat causes them to come to the surface, where they are destroyed, and their calcareous coverings rendered so brittle that they can be crumbled into an impalpable dust between the thumb and fingers.

Different specimens of *H. Cooperi* often present such a great variety of forms that the collector may frequently become confused in seeking to determine them. Sometimes the spire is exceedingly depressed, when the specimen may be mistaken for *Helix strigosa*, while many others are highly elevated and resemble closely large specimens of *Helix Idahoensis*. Near the Grand River, just above its confluence with Piney Creek, I picked up a reversed specimen, which, among this species, is extremely rare. It must be considered as nothing less than a montrosity, yet is exceedingly interesting in showing to what extreme variation the *H. Cooperi* is subject.

(Fig. 42.) REVERSED SPECIMEN OF HELIX COOPERI.

As we advanced southward we found the representatives of this species decreasing in number and size, until, in the southwest portion of Colorado, they are found only occasionally in the defiles of the Sierra La Plata. The higher elevations seem to be more favorable for the full development of mollusks, being a limestone country, while among the lower sandstones land shells are almost unknown. We find, then, that there are certain conditions of climate, elevation, and locality, which are favorable to the satisfactory growth of the hardy and prolific *H. Cooperi*. It seems to thrive better in a temperate than in a torrid climate. It increases more rapidly in numbers, and even in size, in the medium or higher altitudes. It prefers cool, damp, shaded spots, to warm or dry locations. It appears to be confined to the Pacific slope of the Rocky Mountains; for, if it exists at all on the eastern side, it is only met with in reduced numbers.

MICROSCOPES AT THE LOAN COLLECTION OF SCIENTIFIC APPARATUS OF THE SOUTH KENSINGTON MUSEUM.

BY JOHN NICHOLS.

AMONG the relics of early microscopy, the compound microscope, invented and constructed about 1590, by Zacharias Janssen, of Holland, is certainly a very primitive affair. As this, and in fact all the other instruments are inclosed in a glass case, a critical examination is impossible. The outward form presents the simple appearance of an iron or tin tube about ten inches long and about an inch and one half in diameter; the magnifying power is very moderate.

In the same case is a silver microscope, by Anthony van Leeuwenhoeck (born 1632, died 1723), the noted Dutch philosopher and microscopist. It may be remembered that he made a microscope for almost every object, which must have consumed much of his valuable time. This microscope of Leeuwenhoeck's is simple in form, being a silver plate, perforated with a single minute hole, in which is fixed a tiny lens, in front of which, and in focus, is placed a silver needle upon which the object was fixed.

It was with such an instrument that Leeuwenhoeck carried on his wonderful discoveries, and laid the first steps in histological science. What glorious results might have followed had he possessed a modern instrument and objectives!

The great microscope made by Benjamin Martin (1770), for George the Third, is probably the largest and most elaborate instrument ever manufactured. It stands nearly three feet high, and is decorated with much scroll-work, while in all directions are lying the most complicated pieces of accessory apparatus, which must have sorely bewildered the royal scientist. Looking at this piece of scientific magnificence, some comfort is suggested, that if we have not yet reached perfection in designing microscopes, we have at least attained a good degree of simplicity of construction.

There are many other instruments made by the early microscopists, illustrating the progress of the instrument. That made for or by Galileo is of special historical interest. The glasses have been lost; the tube alone remains. The body is an upright, supported on a tripod.

The modern instruments offer no field for comment. One looks in vain for anything novel in construction. There are the

well-known forms of the different makers enclosed in glass cases. Probably the London shop-windows present as great a variety in microscopes as this section of the collection. The instruments are all muddled together without any order or attempted arrangement.

Powell and Lealand do not exhibit. Messrs. Ross & Company exhibit a large instrument on the Jackson slide principle, designed by Mr. F. H. Wenham. The great point in this form is, that the fine adjustment is placed under the instrument, and can be reached without taking the hand from the coarse adjustment. Thus the old objection to this model has been removed. Messrs. R. & J. Beck also have one of their best microscopes, showing great perfection of work; also a cheap form called "The Economic." It is monocular, highly finished, and is altogether a charming instrument and furnished for five and six guineas, with objectives and case.

Mr. Stephenson exhibits his erecting binocular microscope, for which he claims many decided advantages, which should make it extremely useful. The instrument of the future, the comfort of looking through inclined tubes and still having the stage horizontal, and the image in its natural position, certainly marks a great advance in construction.

Mr. J. Browning shows a microscope upon the same model, but with what is claimed to be an improvement. In this instrument, for the first time, the planes introduced by Mr. Stephenson for altering the direction of the rays, so that the microscope can be used with the stage in a horizontal position, have been introduced near the eye-piece in the separate bodies. This arrangement will, it is believed, be found to possess considerable advantage. Such is the official description, which must be taken for granted, as the exterior presents no novel feature.

Swift, who is turning out some of the best moderate-priced optical instruments in London, shows a microscope very similar to Messrs. Beck's "Economic," called the "New College Microscope." Also a new crane arm-binocular. This is an excellent full-sized instrument, and for a good, working microscope, appears all that can be desired, and sold with good objectives at a price within the reach of the student microscopist.

The German manufacturers have sent a few instruments, and are chiefly represented by Messrs. Tiebert and Krafft, and E. Leitz, both of Wetzlar. Respecting these microscopes I noticed nothing special, except that they appeared inferior in workmanship to those exhibited by the London makers.

Among accessory apparatus will be found that used by Messrs. W. H. Dallenger, and J. J. Drysdale, M. D., for the continuous observation of minute organisms. Those who read the *Monthly Microscopical Journal*, know what valuable results were obtained by its use. Would that the faculty to make use of instruments could be sold to the many purchasers.

Microtomes, for cutting sections, are here in great variety and of all sizes. One with a marble basin larger than an ordinary washing-basin. In some of the microtomes the knife is fixed and worked by a piece of mechanism like a lathe rest, such as that made by W. Apel, mechanician to the University of Göttingen. In another microtome the preparation is pressed forward by a micrometer screw, against a circular knife, set in motion by a lathe. This instrument is from the University of Prague.

United States opticians and manufactures are totally unrepresented, which is much to be regretted, as in this section they could have made an excellent show, — perhaps have carried off the palm.

MIMICRY IN BUTTERFLIES EXPLAINED BY NATURAL SELECTION.

FRITZ MÜLLER, whose contributions to science are always worthy of special attention, endeavors in a recent German periodical [1] to show how the phenomena of mimicry in butterflies may be explained by the theory of Natural Selection. He bases his inquiries upon the species of *Leptalis* found in southern Brazil, and although, as will appear below, he adduces reasons for believing the primitive stock to have been banded, and not like most of the family to which this genus belongs, simple white butterflies, he commences by showing how even such an extreme change could be wrought out by the survival of the fittest in the struggle for existence.

"Should," he remarks, "the first unimportant variations from the original white color (of the Pierids) be useful only in attracting to their possessors, at a little shorter distance, the attention of enemies flying carelessly overhead, they would become more and more useful, and cause their possessors to become continually more abundant in proportion to the type; they could therefore serve as the basis for the gradual formation of a resemblance fit to deceive even the sharp eyes of birds scanning the swarms of Ithomias (the butterflies imitated by some Leptalids) for booty."

[1] Jenaische Zeitschrift für Naturwissenschaft, x. i., February, 1876.

Farther on he asserts that "the acceptation, as the starting-point in the origin of mimicry by natural selection, of a resemblance having its beginning at such a distance can scarcely be shaken by a single known case. It should, moreover, not escape attention that the sharp-sightedness of enemies is itself also a quality at first gradually acquired in the struggle for existence, and one which must increase, from the very fact that by protective coloring, mimicry, etc., the persecuted species escapes the less sharp-sighted pursuer. This ever-increasing sensitiveness and sharp-sightedness of the pursuer on the one hand explains the wonderful completeness of many natural imitations, and on the other makes the acceptation of an originally very slight resemblance the less hazardous."

Fritz Müller insists, as all writers on the subject have done, upon the similar geographical distribution of the imitating and the imitated species as a necessary concomitant of mimicry; but instead of believing with other authors that the Leptalids have become poor flyers in their imitation of the feeble-winged *Ithomia*, he holds that the wretched powers of flight possessed by the species of *Leptalis* have been the very cause of mimicry; the insects needed mimicry the more the poorer flyers they were.

Mimicking species of course stand between their original type and the mimicked species; and since mimicry is often confined to the female, we should expect in such cases to find the following series: original form, male of mimetic species, female of same, species mimicked.

In his vicinity, Müller has found five species of *Leptalis*, of which only four are common, and are discussed by him. Of these four, *Lept. Melia* mimics nothing; all the other three are imitative species and mimic distinct groups of butterflies; *Lept. Astynome* resembling a Heliconian-like Danaid, *Mechanitis Lysimnia;* another, which he calls *Lept. Thalia*, mimicking an Acræan, *Acræa Thalia* so closely, that Müller at first supposed it to be an Acræan; and the last, *Lept. Melite*, bearing a close resemblance to the female of one of its own family, *Daptonoura Lysimnia.*

A comparison of the form of the wings of these different insects shows the following series: —

(1.) *Pieris* or *Daptonoura*, *Mechanitis Lysimnia*, *Leptalis Astynome* ♀, *Leptalis Astynome* ♂, *Leptalis Melia.*

(2.) *Pieris* or *Daptonoura*, *Acræa Thalia*, *Leptalis Melia.*

(3.) *Pieris* or *Daptonoura*, *Leptalis Melite* ♀, *Leptalis Melite* ♂, *Leptalis Melia.*

In all these series, *Pieris* (or *Daptonoura*) stands at one end and *Leptalis Melia*, a banded species, but one which, as already remarked, does not imitate any other butterfly, at the other. The mimicking species always stand between the species they imitate and *Leptalis Melia*, and where there is a difference in the sexes, the females resemble most the imitated species, the males *Leptalis Melia*. From this Müller reasonably urges that the original *Leptalis* stock, from which the mimicking species were derived, was allied to *Leptalis Melia* rather than to a *Pieris*, or *Daptonoura*, and that therefore, at the very start, natural selection had the advantage of finding a pliable stock already resembling not a little the bird-shunned Ithomias.

From this he proceeds to a comparison of other relations between the mimicked species, the mimicker, and the non-mimicking *Leptalis*, and discovers that in every instance, and in each particular, the mimicking *Leptalis* stands between *Leptalis Melia* and the mimicked Danaid, Acræan, or Pierid; even in one instance the neuration of the mimicking species is decidedly altered, showing how seriously the structure may be affected by mimicry. Müller studies separately the form of both fore and hind wings, the pattern and coloration of all, entering into many very interesting details, and elucidating the different points by the aid of simple but sufficient illustrations, which our readers will find well worth examining.

PROGRESS OF ORNITHOLOGY IN THE UNITED STATES DURING THE LAST CENTURY.

BY J. A. ALLEN.

EARLY PAPERS.

PRIOR to the year 1808, when the first volume of Alexander Wilson's great work was published, little had been written on American birds by Americans. A few lists of the birds of limited portions of the United States that appeared during the last fifteen years of the eighteenth century constituted our whole ornithological literature at that date. The first of these was a list of about one hundred and twenty species, published by Thomas Jefferson in 1787, in his celebrated Notes on Virginia. This is a catalogue of the species described by Catesby, with the addition, in parallel columns, of the Linnæan and common names, and of the popular names of a few species not described by Catesby, — merely a nominal list of no special importance. This

was followed, in 1791, by William Bartram's enumeration of the birds known to this excellent naturalist as inhabitants of the eastern portion of the United States, published in his Travels in North and South Carolina, Georgia, East and West Florida, etc.; this list embraced about two hundred and fifteen species, and, though mainly a nominal one, was accompanied by typographical signs indicating the range of the species at the different seasons of the year, while a few were described at some length in other parts of the same work. In many cases Linnæan names were used for the designation of the species; but to the larger number he gave new names, which, being generally unaccompanied by descriptions, are now to a very large extent undeterminable. This paper is especially noteworthy as forming the first important contribution by an American to American ornithology.

The next paper in order of time was by Jeremy Belknap, who in his History of New Hampshire (vol. iii.), published in 1792, devoted ten pages to birds, giving a list of about one hundred and sixty species. The current Linnæan names were used, to which a few new names were added. Although no descriptions are given, the names generally clearly indicate the species meant. Though not commonly referred to by scientific writers, it forms a highly important paper and one worthy of attention. Samuel Williams, in his Natural and Civil History of Vermont (published in 1794), devoted also about the same number of pages to the birds of Vermont. Scientific names of about fifty species are given in full, and the generic names of a dozen others. The paper also embraces a number of pages of valuable notes. These two last-named articles show that several species were then common in New Hampshire and Vermont that long since became extinct there, and are hence papers of considerable historic interest. In 1799, Benjamin S. Barton published his Fragments of the Natural History of Pennsylvania; this rare folio contains a list of the birds of Pennsylvania, with notes on their migrations.

Although John Clayton published a valuable paper on the birds of Virginia as early as 1693 (Philosophical Transactions, vol. xviii.), and although many enumerations of a few of the birds of many portions of the Atlantic States, from Florida to Maine, were made by different writers during the seventeenth and eighteenth centuries, some of which possess especial value in a historic point of view, the four papers already mentioned constitute the bulk of the ornithological literature written by Americans prior to the time of Alexander Wilson.

GENERAL WORKS.

Alexander Wilson, a Scotchman by birth, came to America in 1794, and some ten years later conceived the idea of writing a history of the birds of his adopted country. Receiving hearty encouragement from his kind friend, Mr. William Bartram, he entered seriously upon his great work in 1805, to which he devoted almost his whole time and energy till his untimely death in 1813. The first volume appeared in 1808, followed by eight others, the last two of which were published after his death, under the editorship of Mr. George Ord. Of these nine folio volumes, accompanied by colored plates, Bonaparte wrote in 1825 as follows: "We may add, without hesitation, that such a work as he [Wilson] has published in a new country is still a desideratum in any part of Europe." His earlier figures were sometimes stiff and awkward, but they were generally of a high grade of excellence for that time, and his descriptions were concise and exact. His accounts of the habits of many of the species have rarely been surpassed in point of truthfulness or felicity of expression. Never extended by irrelevant matter, some of them are models of descriptive writing, evincing a poet's love and appreciation of nature. Although adopting Pennant's system of classification, by far the best then extant, the species were not systematically grouped, but taken in the order in which they most conveniently came to his hand. Had he lived to complete his work, many others would doubtless have been added, and the whole rearranged in accordance with his own ideas of their affinities.

The work so well begun by Wilson was continued by Bonaparte, whose American Ornithology, or the Natural History of the Birds inhabiting the United States, not given by Wilson, was extended to four volumes, similar in style to those of Wilson. The first appeared in 1825, the second and third in 1828, and the fourth in 1833.

Several editions of Wilson's work were subsequently issued, either separately or combined with Bonaparte's continuation. The first American edition was that published by George Ord, in 1828–29, in three octavo volumes of text and a folio volume of plates. In this work the species are arranged systematically, but the editor adhered to the original text, correcting merely a few erroneous references and verbal inaccuracies. In 1831, Jameson published in Edinburgh an 18mo edition of Wilson's and Bonaparte's works. The succeeding year this was followed

by Jardine's edition (London and Edinburgh, 1832), in three octavo volumes, of the same authors. This last was reissued in this country in 1840, in one volume, with the addition of a Synopsis of the Birds of North America, by Dr. T. M. Brewer. Of this there were subsequently several reprints from the same stereotyped plates.

In 1827, John James Audubon began the publication of his celebrated work on North American birds, which was not completed till 1839. The whole work forms five octavo volumes of text, with an elephant folio atlas in four volumes of four hundred and thirty-five plates. The text was published in Edinburgh, with the title of Ornithological Biography; the plates in London, as Birds of America. This magnificent work remains as yet unequaled in respect to its illustrations, which are unrivaled in point of accuracy and life-like character, the birds being all represented of the size of life. In his animated descriptions there is at times a tendency to exaggeration and redundancy of personal incidents. The species are arranged according to the convenience of the author, a systematic arrangement being in such a work obviously impracticable. In 1839, however, on its completion, the author published his Synopsis of the Birds of North America. In this work the nomenclature is revised and greatly changed, principally through the adoption of many of the then recently introduced generic designations. This Synopsis (one volume, octavo, Edinburgh) was a methodical catalogue of all the species at that time known to inhabit North America north of Mexico, and was intended to serve as a systematic index to his Ornithological Biography, and Birds of America. The work, however, is much more than this, giving, as it does, the characters of the families, genera, and species, the range of each species, and numerous bibliographical references. It includes also a few species not given in his larger works.

Subsequently Audubon republished his Ornithological Biography, and Birds of America in a single work, under the title of Birds of America. This is simply a reissue of the text of the former, with the species systematically arranged under the names employed in the Synopsis, and the addition of the plates of the large folio work, reduced by the camera lucida. This work was published at Philadelphia (1840 to 1844), in seven imperial octavo volumes. It has also been since republished in New York, with chromo-lithographic illustrations of a character far inferior to those of the original work. The appendix to the

seventh volume includes a few species previously unpublished by this author.

In 1832 appeared the first volume of Thomas Nuttall's Manual of the Ornithology of the United States and of Canada, embracing the land-birds. This was followed in 1834 by the second volume, devoted to the water-birds. A new edition of the land-birds was published in 1840, including all the species discovered in the mean time by Townsend and Audubon. These two volumes (12mo, Boston), illustrated with numerous small wood-cuts, contain a succinct history of the birds of North America known at the time of their publication, and, being written in a pleasing style, form a work that has been deservedly popular, despite many inaccuracies, and has recently been republished.

The next general work on the birds of North America was John Cassin's Illustrations of the Birds of California, Texas, Oregon, British and Russian America. This was published in parts (Philadelphia, 1853–55), and was intended to contain descriptions and figures of all North American birds unfigured by previous authors, and a general synopsis of North American ornithology. It was issued in ten parts, with fifty plates. The author's plan of continuing the work was probably superseded by the preparation soon after of a far more important work, in the labor of which Mr. Cassin shared.

Dr. T. M. Brewer's North American Oölogy (Smithsonian Contributions, vol. xi.), published in 1857, is the only American work devoted exclusively to the eggs and breeding habits of North American birds. It is, however, as yet uncompleted, Part I. (quarto, pp. 140) embracing the *Raptores* and *Fissirostres*, being the only portion yet published. The five colored plates give figures of the eggs of all the species of these groups at that time accessible, while the text contains a very full account of the distribution and breeding habits of the species embraced.

In 1858 appeared the well-known General Report on the Birds of North America, forming volume viii. of the Pacific Railroad Reports of Explorations and Surveys. This was the joint work of Spencer F. Baird, John Cassin, and George N. Lawrence, the parts devoted to the *Raptores*, *Grallæ*, and *Alcidæ* being by Mr. Cassin, while Mr. Lawrence wrote that relating to the *Longipennes*, *Totipalmes*, and *Colymbidæ*, the remainder being by Professor Baird, the whole work making a quarto volume of over one thousand pages. The abundant material at the command of these eminent authors, and the elaborate and critical

manner in which it was treated, render this work by far the most complete and important, in a scientific point of view, that had at that time appeared relating to North American ornithology, or, in fact, to any similar area anywhere. It is, however, a strictly technical treatment of the subject. The special reports on the ornithology of the different routes explored, contained in other volumes of this series of reports, supplemented this general work with much biographical matter, in connection with which appeared thirty-eight finely executed colored plates of species described in the general and special reports, but previously unfigured by American authors. This was followed in 1859 by Professor Baird's report on the Birds of the United States and Mexican Boundary Survey, with twenty-five admirable plates of previously unfigured species. In 1870, the text of the General Report was re-issued, with some additional matter, under the title of Birds of North America, with an accompanying volume of one hundred plates, including those above-mentioned as accompanying the special reports of the Pacific Railroad and Mexican Boundary Surveys.

In 1864 Professor Baird began the publication of his Review of American Birds (Part I. North and Middle America, Smithsonian Miscellaneous Publications, No. 181). Installments of the work were published at intervals during the next two years, the last signature bearing the date of "June 9, 1866." The work, so far as published, forms an octavo volume of 450 pages, taking the *Oscines* as far as the genus *Collurio*. The very thorough character of this much-needed work renders it a source of sincere regret that its busy author has not found time to carry it forward to completion.

In 1869 appeared D. G. Elliot's work (two volumes in one, folio, New York), entitled New and Unfigured Species of the Birds of North America, containing sixty-four colored plates, and short critical notices of one hundred and fourteen species. This was followed in 1870 by Cooper's Birds of California, edited by Professor Baird "from the manuscript and notes of J. G. Cooper." We have as yet of this important work only the first volume (forming volume i. of the Zoölogical Reports of the Geological Survey of California, Professor J. D. Whitney, director), embracing the land-birds. This is a quarto of six hundred pages with life-size colored figures of the heads of each species and small full-length figures of some species of each genus, *inserted in the text*. This method of illustration was novel and advan-

tageous to the student, the work being intended as a manual of the ornithology of the whole region west of the Rocky Mountains north of Mexico.

The next general work on North American birds is Dr. Elliott Coues's Key to North American Birds (one volume, quarto, with upwards of 250 wood-cuts and six steel plates), published in October, 1872. This highly useful and deservedly popular work is unique in ornithological literature, being a manual of the birds of North America, designed especially for the use of students, in which are introduced analytical tables for the determination of the species, similar in character to those so successfully adopted in botanical text-books. This was followed, in 1874, by the same author's Field Ornithology and Check-List of North American Birds, intended as a supplement to the Key, the first part being a "manual of instruction for procuring, preparing, and preserving birds," and the latter, as its title implies, a "check-list" of the species.

By far the most important recent work on North American ornithology, however, is the joint work of Prof. S. F. Baird, Dr. T. M. Brewer, and Mr. Robert Ridgway, published under the title of Birds of North America. The first three volumes of this indispensable work, embracing the land-birds, appeared in 1874, the portion relating to the water-birds being still in course of preparation. The more technical portion is the joint work of Professor Baird and Mr. Ridgway, while the biographical portion is written by Dr. Brewer. This work, it is needless to say, represents the most advanced views of our best authors, and must long remain the leading authority on the subject of North American ornithology. It is illustrated with five hundred and ninety-three wood-cuts, devoted largely to the external anatomy, and sixty-four colored plates giving life-size figures of the heads of the greater part of the species and varieties. Later works possessing a general character are Dr. Elliott Coues's Birds of the Northwest (1874), and Mr. H. W. Henshaw's recent Report (1875) upon the ornithological work of the Survey of the Territories West of the One Hundredth Meridian. The first of these is an octavo of nearly eight hundred pages, forming No. 2 of the Miscellaneous Publications of Dr. F. V. Hayden's Geological Survey of the Territories. The work is intended as a hand-book of the region drained by the Missouri River and its tributaries, and hence embraces a wide field. Giving as it does a summary of the ornithology of this extensive region, combining much new

matter with much previously published in scattered papers, and the fullest tables of bibliographical references for the larger part of the birds of North America that has yet appeared, it is a work of the highest value to students of American ornithology.

Mr. Henshaw's work (Chapter III. of vol. v. of the Reports of the Geological and Geographical Surveys West of the One Hundredth Meridian, under Lieut. G. M. Wheeler) is limited to the actual work of the Wheeler Survey, of which it presents a general systematic summary, based on the collections and field-notes made chiefly by the author and Drs. Yarrow and Rothrock, and Messrs. Bischoff and Aiken, and is hence made up wholly of original matter, adding largely to our knowledge of the ornithology of this previously little-known region. It is accompanied by fifteen chromo-lithographic plates of previously unfigured species and varieties, and embraces about five hundred quarto pages of text.

WORKS AND PAPERS OF A SPECIAL OR LOCAL CHARACTER.

The long list of general works by no means comprises all the important contributions made by Americans to North American ornithology. The special papers, many of them of a high scientific value, are too numerous to be mentioned even by name within the limits of the present paper. These number several hundred, varying in length from a few pages to hundreds each. While a considerable proportion are limited to the descriptions of a few new or little-known species, or to the enumeration of the species found at particular localities, others are exhaustive monographs of genera or families, or are devoted to a discussion of general questions of nomenclature, of the geographical distribution of the species, or of laws of geographical variation.

Of papers of a strictly local character may be mentioned the Rev. W. B. O. Peabody's Report on the Birds of Massachusetts (Fishes, Reptiles, and Birds of Massachusetts, 1839); Zadock Thompson's chapter on the Birds of Vermont (Natural, Civil, and Statistical History of Vermont, 1842); J. P. Giraud's Birds of Long Island (8vo, 1844); Dr. J. E. Dekay's Report on the Birds of New York (New York Zoölogy, Part II., one vol. 4to, with colored plates, 1844); E. A. Samuels' Birds of New England (8vo, pp. 600, 1867); C. J. Maynard's Birds of Florida (now publishing in parts); and T. G. Gentry's Life-Histories of the Birds of Eastern Pennsylvania (vol. i., 1876), the two latter still in course of publication. Linsley's Catalogue

of the Birds of Connecticut (American Journal of Science and Arts, first series, vol. xliv., 1843), and Wm. M. and S. F. Baird's List of the Birds of Carlisle, Pennsylvania (ibid., vol. xlvi., 1844), are noteworthy, as being the first of a long series of papers of a strictly faunal character that have contributed so much to our knowledge of the distribution of our birds, their periods of migration, and their seasonal ranges throughout the eastern half of North America from Labrador to Florida. For notes on the avifauna of Labrador and Anticosti, we are indebted to Coues, Verrill, and Packard; Drs. Brewer and Bryant have written on the birds of New Brunswick and Nova Scotia; Cabot, Holmes, Boardman, Verrill, and Hamlin on those of Maine, and Maynard and Brewster on those of Maine and New Hampshire; Emmons, Brewer, Putnam, Samuels, Allen, and Maynard on those of Massachusetts; Linsley and Wood, and others, on those of Connecticut; Coues and Brewer on those of New England in general; Lawrence and Fowler on those of New York; Abbott and Turnbull on those of New Jersey; Taylor, the Bairds, and Barnard on those of Pennsylvania; Coues and Webster and Jouy on those of the District of Columbia; Scott and Brewster on those of West Virginia; Burnett, Gibbs, Cope, and Coues on those of North and South Carolina; Bryant and Allen on those of Florida; Kirtland, Read, Kirkpatrick, and Wheaton on those of Ohio; Haymond and Allen on those of Indiana; Kennicott, Pratten, Allen, Ridgway, and Nelson on those of Illinois; Kneeland, Hughs, and Covert on those of Michigan; Head, Trippe, and Hatch on those of Minnesota; Hoy and Barry on those of Wisconsin; Allen, Parker, and Trippe on those of Iowa; Hoy on those of Missouri; Roemer, McCall, and Butcher on those of Texas; Coues, Allen, Snow, and others on those of Kansas; Allen, Aiken, Holden, Trippe, and Henshaw on those of Colorado and Wyoming; Hayden, Cooper, Allen, and Coues on those of the Upper Missouri country; Townsend, Cooper, Suckley and Bendire on those of Oregon; Baird, Allen, Ridgway, and Henshaw on those of Utah; Henry, Baird, and Henshaw on those of New Mexico; Coues, Henshaw, and Yarrow on those of Arizona; Ridgway, Henshaw, and Yarrow on those of Nevada; Xantus, Feilner, Brewer, Gambel, Heerman, Cooper, Ridgway, Nelson, and Henshaw on those of California; and Dall, Bannister, H. W. Elliott, and Coues on those of Alaska. Other writers on the birds of the far West are Say, Woodhouse, Kennerly, Newberry, Suckley, Stevenson, and Merriam.

Among the numerous papers of a critical or monographic character may be mentioned Bonaparte's Observations on the Nomenclature of Wilson's Ornithology, published in 1824–26 (Journal of the Academy of Natural Science, Philadelphia, vols. iii., iv., v.), in which were first introduced into the annals of North American ornithology a large proportion of the generic names now in current use, a few only of which were first proposed in this essay. It created, however, a revolution in the Wilsonian nomenclature. Audubon's Synopsis (1839) again brought down the nomenclature to the date of its publication, through the adoption of the changes made necessary by the further increase of knowledge. The Audubonian nomenclature was generally in use in this country till the appearance of Baird, Cassin, and Lawrence's great work in 1858, when a number of new generic and subgeneric names were proposed, and the nomenclature again modernized. Comparatively few generic names have since been introduced, but revisionary work of a somewhat different character (to be noticed later) has already greatly modified the nomenclature of 1858.

Among revisionary papers of a minor but more general character are numerous critical essays by Cassin, especially on the *Icteridæ* and *Picidæ*, the *Raptores*, the *Cærebidæ*, *Caprimulgidæ*, etc.; by Baird, in his Review of American Birds; by Coues among the *Laridæ*, *Procellariidæ*, *Grallæ*, *Colymbidæ*, *Spheniscidæ*, etc.; by Ridgway among the *Raptores* and by Bannister among the *Anseres*, etc. Of separate monographic papers may be mentioned those of Coues on the genus *Ægiothus*, the *Tringæ*, *Alcidæ*, etc., Bryant on the genus *Cattaractes*, and Ridgway on various groups of the *Raptores* and *Oscines*, the genus *Leucosticte*, etc.

The anatomy and embryology of our birds have not received the attention these subjects deserve, but a number of papers have appeared treating more or less in detail of particular points. Dr. Coues has published an account of the myology of *Colymbus torquatus* and various notes on the structure of the *Spheniscidæ;* Streets has written on the characters of the skull in birds, and Mr. Ridgway has called attention to various points in the osteology of the *Raptores*. Agassiz and Wyman have noticed a few points in the development of birds, while Prof. E. S. Morse has carefully studied the development of the tarsus and carpus with results confirmatory of the previously suspected affinities existing between birds and reptiles.

Not only has the geographical distribution of North American birds been studied in connection with the general history of each species, but attempts have been made to discover and limit the different faunal areas of the continent, special attention having been given to this department of the subject by Baird, Verrill, Allen, and Ridgway, and incidentally to a less extent by others. The subject of geographical variation has also been thoroughly investigated, with results of high importance, which will later be referred to more fully. Among the prominent workers in this field are Baird, Allen, Coues, Ridgway, and Henshaw, while the subject has received much attention from others.

Within the last ten years also a field previously wholly unexplored has been opened up, that of palæontological ornithology, mainly through the labors of Professors O. C. Marsh and E. D. Cope, the former of whom has alone made known, mostly in preliminary papers, the remains of upwards of thirty species, found in the Cretaceous green-sands of New Jersey, and the Cretaceous and Tertiary formations of Kansas, Colorado, and Wyoming. Those described by Professor Cope are likewise mainly from the same localities.

Much has also been written by American ornithologists on exotic birds, especially on those of Central and South America. In 1838, J. P. Giraud described "sixteen new species" of Mexican birds, and Dr. S. Cabot published (1842 to 1844), several papers on the birds of Yucatan, describing a number of new species. Mr. George N. Lawrence has published numerous papers on the birds of Mexico, the West Indies, and Central and South America, and Dr. Bryant on the birds of some of the Lesser Antilles. Cassin published not only on the birds of Central and South America, but also on those of Africa and other distant countries, including reports on the collections made by the United States Exploring Expeditions under Commodores Rogers and Wilkes. Baird's Review of American Birds treats largely of the birds of tropical America, and some of the monographic and revisionary papers of Coues and Ridgway have taken a wide range. D. G. Elliot has published elegantly illustrated monographs of the *Pittidæ*, the *Phasianidæ*, and the *Tetraoninæ*, and many papers on different genera of the humming-birds and other exotic groups, mostly, however, prepared and published abroad. Professor Alpheus Hyatt has published a monograph of the *Spheniscidæ*, and Drs. Kidder and Coues reports on the birds of Kerguelen Island; the present writer reports on collec-

tions of birds made at Lake Titicaca, and at Santarem, on the River Amazons. Prof. James Orton has also published on the birds of Ecuador, and the Rev. J. H. Bruce on those of India.

Among the many aids to a better knowledge of American birds should be mentioned the explorations of Kennicott, Dall, H. W. Elliott, Bannister, and Bischoff, in British North America and Alaska, conducted under the auspices of the Smithsonian Institution, several of whom have forwarded to Washington immense collections of the birds of the Northwest. The surveys of our western Territories made under the direction of the War Department should be especially mentioned as among the auxiliaries of ornithological science in this country, the various government expeditions having been usually accompanied by competent naturalists. The recent surveys (still fortunately in progress) under the Department of the Interior have likewise been productive of important results. The numerous correspondents of the Smithsonian Institution, both in the boreal and in the tropical portions of the continent, though not always citizens of the United States, have added greatly to our store of ornithological material and knowledge. The several naval exploring expeditions have also contributed, from distant foreign shores, rich stores of specimens and facts. Among more private enterprises should not be forgotten the Thayer and Hassler expeditions from the Museum of Comparative Zoölogy to South America, both of which returned with rich ornithological collections, numbering in the aggregate thousands of specimens. The expeditions of Professor Orton, Mr. Alexander Agassiz, and Mr. Linden have also been fruitful in ornithological results. Of the explorations of Dr. Bryant in the West Indies, and of numerous other ornithological explorers elsewhere, the want of space forbids a further notice.

SUMMARY OF PROGRESS.

When Alexander Wilson, the "Father of American Ornithology," began his great work, less than three fourths of a century ago, probably not a dozen species of American birds had been scientifically described by American writers, and almost nothing had been published relating to their distribution or habits. On the completion of Bonaparte's continuation of Wilson's work in 1833, about four hundred species had been described by these two authors, of which colored figures had also been published, with a more or less full account of the habits and range of each species. In 1833, Bonaparte (in his Geographical and Compar-

ative List) gave the number of North American species as four hundred and seventy-one, while in 1839 the number described by Audubon (in his Synopsis) was four hundred and ninety-one. Nearly all of these had been re-figured by Audubon, the figures being all of life size, and as yet unsurpassed in fidelity or artistic effect. Audubon had likewise largely increased our knowledge of their distribution and habits, while the greater part had, moreover, found a valuable biographer in Thomas Nuttall. The publication of numerous minor papers had also contributed largely to a better knowledge of many of the species.

In 1844 the number of species had increased to five hundred and six, the number given by Audubon in his Birds of North America. In 1858 the number had risen to seven hundred and sixteen, all of which had been ably elaborated by the authors of the General Report, their affinities thoroughly discussed, and their nomenclature carefully revised. In the mean time numerous special papers had appeared relating to their habits and distribution. Yet the nests and eggs, and even the winter and summer resorts, of many of the species still remained unknown.

From this time onward information respecting our birds increased more rapidly than before; new workers came prominently into the field, and a rapid advance marked every year. At the present time the number of generally accepted species entitled to recognition as birds of that portion of North America north of Mexico is not less than six hundred and fifty, with, in addition, about one hundred and fifty commonly recognized subspecies, or about eight hundred recognized forms. The nests, eggs, and general habits of nearly all are now well known, particularly of those which occur east of the Rocky Mountains. Among the recently discovered extinct species have been found entirely new types representing what is believed to be a new sub-class, they having true teeth and other characters assimilating them to reptiles, between which and true birds they undoubtedly form connecting links.

Another phase of progress that should not pass unnoticed in this connection is the attention that has been paid to the geographical distribution of the species, with especial reference to the determination of the different faunal areas in North America, many of which are already known with a tolerable degree of definiteness; also the tendency to study the various sub-specific and specific forms from a geographical and evolutionary standpoint. Formerly the study of our birds was pursued wholly

analytically, and forms from distant, little-known localities which differed slightly from their near affines of neighboring regions were looked upon as distinct "species." Later, as the material for a better knowledge of the subject accumulated, specimens of an intermediate character came to light, which, so long as they were few, were naturally looked upon as probably hybrids between the forms whose characters they seemed to combine. Still later, however, it was found that certain strains of deviation from pronounced types occurred in a large number of species belonging to widely different families inhabiting the same areas. This led to the discovery of laws of geographical variation, connecting particular phases of local differentiation with the topographical and climatic peculiarities of the regions where they so uniformly occur. Many of the isolated facts bearing on this subject had been observed and placed on record prior even to 1860, but their full import was not realized till after the lapse of another decade, during which our stores of material had become vastly increased. In 1871 the "new departure" was for the first time fairly entered upon, which in three years revolutionized the nomenclature of North American ornithology, adding an important chapter to philosophical zoölogy, and exerting great influence in many other departments of North American zoölogy. Naturally, a view that threatened either to assign fully one sixth of the previously recognized species to the limbos of synonomy or to lower them to the grade of geographical races was not rashly espoused by those to whom belonged the credit of the recognition and description of these previously supposed specific forms; but so overwhelming were the facts in its favor found to be, that one after another of our leading writers soon gave it their indorsement, so that probably a greater degree of unanimity of opinion respecting any problems in ornithology never obtained, than now exists among our ornithologists respecting the subject of geographical variation among our birds and the sub-specific relationship of many forms which when first made known seemed unquestionably of specific rank.

The next step, and apparently a wholly logical one in the revolution, will doubtless be the general adoption of a trinomial system of nomenclature for the more convenient expression of the relationship of what are conventionally termed "sub-species," so that we may write, for instance, *Falco communis anatum* in place of the more cumbersome *Falco communis* subsp. *anatum*. This system is already, in fact, to some extent in use here,

though looked upon with strong disfavor by our transatlantic fellow-workers, who seem as yet not fully to understand the nature of the recent rapid advance ornithology has made in this country, or to appreciate the thoroughly substantial nature of the evidence on which it is based. The constant and energetic exploration of the great North and Northwest, of the vast trans-Mississippian region, and of our sub-tropical borders, during the last two decades, by scores of indefatigable collectors and observers, has certainly not been in vain, as witness the hundreds and often thousands of specimens of single species, representing the gradually varying phases presented at hundreds of localities, that have passed through the hands of our specialists.

While the field of North American ornithology is far from an exhausted one, the progress made during little more than a half century is certainly creditable to American enterprise and to American students, though to Americans alone, of course, belongs only a share of the credit of the marked advancement.

In a short article like the present, devoted exclusively to what Americans have accomplished, justice can hardly be done to all, nor is there room to more than allude to the fact that much has been done in aid of the general advance by numerous foreign writers. By no means have all the names of even Americans that are deserving of recognition here, been mentioned in the present article, nor have all articles been cited that are entitled to a high degree of prominence; the omissions, however, are those of limitation and not of choice. Neither is there space to notice the several important ornithological collections that have been gathered, to which alone many pages might be profitably devoted.

RECENT LITERATURE.

ORTON'S COMPARATIVE ZOÖLOGY.[1] — The plan of this book is excellent, and the distribution of the various subjects well carried out. The first half of the book is devoted to comparative anatomy and physiology, containing chapters with titles such as these: Plants and Animals distinguished, Life, Organization, The Food of Animals, How Animals eat, How Animals breathe, Secretion and Excretion, How Animals move, The Nervous System, Development. This portion of the work is more carefully prepared than the second, on classification. Now and then, but not often, we notice a slip of the pen, as "structureless

[1] *Comparative Zoölogy, Structural and Systematic.* For Use in Schools and Colleges. By JAMES ORTON, A. M. New York: Harper and Brothers. 1876. 12mo, pp. 396.

sponge," whereas the sponge is a many-celled animal, with ciliated epithelium, and producing eggs and spermatic particles. On page 164 the figure of the nervous system of a starfish will scarcely do, as in nature but a single nerve is sent to each ray, and the ganglia are not at all as represented by the artist. In the section on instinct and intelligence, which in the main is excellent, the author remarks of the bee, "We do not find one clever and another stupid." We had supposed that observers had noticed a marked individuality among bees and other social insects. As regards the beaver (see page 184), Mr. Morgan has well shown that it acts by reason as well as instinctively. "The egg" of the Amœba is spoken of on page 191, though no rhizopods are known to reproduce by eggs; for this reason the statement on page 188, that "all animals, without exception, arise from eggs," should be modified, as there are whole orders of Protozoa which do not produce eggs. On page 201 it is said that the "grand characteristic" of the vertebrate embryo is the primitive stripe, "which does not exist in the egg of any invertebrate." It is known to exist in the eggs of the leech, earthworm, and allied forms, and with very rare exceptions in the eggs of all insects yet observed. Still this portion of the work is well written, in a clear, lively, and attractive style, and the book is certainly nowhere dull reading.

In some respects we are disposed to find fault with the portion on classification, though on these points naturalists are of many minds. Certainly the many-celled sponges do not belong with the Protozoa, nor are they compound Amœbæ. The Gregarinæ are not "the simplest animal forms of which we have any knowledge," though the author rejects the *Monera* of Haeckel. The Polyzoa, Brachiopods, and Tunicata are retained among the Mollusca, and in fact the classification is not to our mind so advanced in its treatment as other parts of the work. The old division of *Entomostraca* is retained, though Limulus represents quite a different division of Crustacea. On page 276 the lobster, represented by a time-honored English cut, is called *Astacus marinus*. The Arachnida are by the author provided with "antennæ," though they do not exist in nature. Much space is devoted to the vertebrates, as seems necessary in such a book as this, which has many useful features about it adapting it for use in schools. The three hundred and fifty wood-cuts are in almost every case, we should judge, borrowed from other works, and a larger number represent European animals than is suitable in a book designed for use by American youth.

Recent Books and Pamphlets. — Practical Botany, Structural and Systematic, the latter Portion being an Analytical Key to the Wild Flowering Plants, Trees, Shrubs, Ordinary Herbs, Sedges, and Grasses of the Northern and Middle United States east of the Mississippi. By August Kœhler. Copiously Illustrated. New York: Henry Holt & Co. 1876. 12mo, pp. 400. $3.00.

The Andes and the Amazon; or, Across the Continent of South America. By James Orton, A. M. Third edition, revised and enlarged, containing Notes of a Second Journey across the Continent from Para to Lima and Lake Titicaca. With

two Maps and numerous Illustrations. New York: Harper & Brothers. 1876. 12mo, pp. 645.

Sexual, Individual, and Geographical Variation in *Leucosticte tephrocotis*. Geographical Variation among North American Mammals, especially in Respect to Size. By J. A. Allen. (Extracted from Bulletin of the Geological and Geographical Survey of the Territories, vol. ii., No. 4.) Washington, July 1, 1876. 8vo, pp. 30.

Notes on the Geology of Northeastern New Mexico. By O. St. John. (Extracted from the Bulletin of the Geological and Geographical Survey of the Territories, vol. ii., No. 4.) Washington, July 1, 1876. 8vo, pp. 280–308.

Archivos do Museu Nacional do Rio de Janeiro. Vol. i., 1 Trimestre. Rio de Janeiro. 1876. 4to, pp. 30.

The Oaks of the United States. By Dr. G. Engelmann. (From the Transactions of the Academy of Science of St. Louis, vol. iii.) St. Louis, Mo. 1876. 8vo, pp. 20.

Notes on Agave. By Geo. Engelmann, M. D. (From the Transactions of the Academy of Science, of St Louis, vol. iii.) St. Louis, Mo. 1875. 8vo, pp. 35.

The Forest. Products of Michigan at the Centennial Exposition. By Prof. W. J. Beal. Lansing, Mich. 8vo, pp. 16.

Micro-Photographs in Histology, Normal and Pathological. By Carl Seiler, M. D., in conjunction with J. Gibbons Hunt, M. D., and J. G. Richardson, M. D. Vol. i., Nos. 1, 2. Philadelphia: J. H. Coates & Co. 4to, 8 Plates.

GENERAL NOTES.

BOTANY.[1]

SCHŒNOLIRION; APPENDIX. — About the time when my little article on *Schœnolirion*, for our July number, was issued, a valued Californian correspondent, Mrs. R. M. Austin, rediscovered the doubtful species referred to, namely, *S. album* of Durand, and sent me specimens which have just come to hand. Pratten's specimen, the only one before known, consisted merely of the top of a scape, with the raceme. I have not seen it, and it is probably in Durand's herbarium, at the *Jardin des Plantes*, Paris. But Dr. Torrey's remarks leave no doubt as to the identification, and the specimens (now complete, except as to the fruit,) justify his reference of the plant to his genus *Schœnolirion*. Nevertheless it differs somewhat from the Atlantic species in the particulars mentioned by Dr. Torrey, and especially in the texture of the dried perianth, which is scarious, in the manner of *Allium*. Moreover, only its outer divisions answer to the description as to the three "almost confluent nerves," the three inner divisions being strictly one-nerved. Besides, the ovary is short-stipitate. The ovules in this and the original species of Michaux are geminate and ascending, not "horizontal." The diagnosis of this fourth species may accordingly be expressed as follows: —

S. ALBUM Durand. Leaves rather flaccid; flowers very numerous in a virgate raceme: pedicels horizontal, shorter than the bracts or the perianth: the latter bright, white, scarious when dry; the divisions nerveless, except the midrib, which is triple in the three outer, but simple in the inner: filaments subulate, decidedly perigynous: ovary short-stipitate. California, in Nevada County, *Mr. Pratten;* Plumas County, *Mrs. R. M. Austin.*

[1] Conducted by PROF. G. L. GOODALE.

It may now be added that the character "rhizomate bulboso-tuberosa," by Dr. Torrey, is by no means correct, and the "root a tuberous rhizoma," of Dr. Chapman, is still less applicable to any species except *S. Elliottii*, and not perhaps properly to that. *S. croceum* and *S. Texanum* have a small but distinct tunicated bulb, the coats fleshy and not numerous, and from the base of this apparently a fusiform root proceeds. *S. album* shows a similar bulb, from the corner of which beneath springs a cluster of rootlets. Our specimens of *S. Elliottii*, all from Dr. Chapman, are indeed destitute of bulb, and show something like a rhizoma. Good specimens showing the underground growth of all these plants are now much wanted.

S. Elliottii not rarely branches its raceme into a panicle. This genus, therefore, presents two difficulties in the way of Mr. Baker's new arrangement of the Liliaceous tribes. It seems to me not remotely related to *Nolina;* but the pedicels are always solitary. — A. Gray.

Sedum reflexum L. — This Old World *Sedum*, which is occasionally met with in old-fashioned gardens, has established itself at Pigeon Cove, Essex County, Mass., as we learn from Mrs. Alonzo Wheeler, who has sent living specimens. It occupies an old stone-heap, in a patch a yard or two in diameter, where "Mrs. Sarah Ann Colburn says she noticed it when she was a very little girl, at least sixty years ago," and whence she transplanted some of it to the cemetery at Folly Cove, thirteen years ago. As the station of the plant is only a few rods distant from the ancient dwelling known as "the Garrison House" (a view of which in a wood-cut adorns the twenty-first page of Mr. Leonard's Pigeon Cove and Vicinity), we cannot doubt that it is an escape from gardens, although the species is not handsome enough to reward cultivation, The plants still carry some marks of former cultivation: first, in the augmentation of the normal number of parts in the blossom. Instead of five in the calyx and corolla, or even six, which is not rare in the wild plant in Europe, there are mostly from seven to nine or ten, so that the plant assumes the technical character of *Sempervivum*. Secondly, these flowers are apt to run together into a sort of crest, and to make a somewhat fasciated inflorescence, or a dense cluster, from which, later, pedicels spring in a proliferous manner. We do not wonder that Mrs. Wheeler was puzzled with it. Still she divined that it was some vagarious *Sedum*, not in the ordinary books. — A. Gray.

A New Fir of the Rocky Mountains. — While collecting in the Wasatch Mountains, in Eastern Utah, last summer, for Major Powell's Survey of the Colorado, I obtained five species of fir, two of which possess a special interest, growing out of the confusion which has heretofore existed respecting the group to which they belong, and the fact that one of them bids fair to be established as a new species. The other turns out to be *Abies concolor* Eng., and not *A. grandis* Lindl., as was supposed, and under which name this tree has been several times reported.

The leaves of my specimens are not glaucous above, but underneath only or not at all, this character not being a constant one. This tree is there known to the Mormon lumbermen as "black balsam" and makes an excellent quality of lumber. It is rarely found above 8500 feet altitude, or below 7000 feet.

But there was another tree there, very much resembling this in its botanical characters, though differing widely in other respects, which I well knew to be a different thing, and as it answered to no description I could find, I became deeply interested in it. In altitude it commences just where the other leaves off, and continues on up nearly to the timber line, or over 11,000 feet altitude. I found it both in the basin of the Sevier River, above Gunnison, and also far to the eastward across the divide on the Colorado side, high up on the slopes of Aquarius Plateau and Thousand Lake Mountain. This tree is distinguished by the lumbermen of that region as "white balsam." It is also known as "pumpkin pine," the wood being rather spongy and poor for lumber. But otherwise it is a much finer tree than *A. concolor*, being very tall and straight, with few limbs from its lower trunk. Of both species I brought back specimens, not only of the leaves, cones, etc., but also sections of the trunk for exhibition at the Centennial, where they may now be seen in Dr. Vasey's excellent collection sent from the Department of Agriculture. I also sent specimens to Dr. Engelmann for identification, from whose report, as follows, it appears that both the species above mentioned have been heretofore confounded under the name of *A. grandis* Lindl., inapplicable to either.

"*Abies subalpina* is the provisional name Dr. Engelmann gives to that fir which occupies the highest wooded regions up to the limits of vegetation in the Rocky Mountains, from Colorado northward and westward to Oregon. In lower altitudes it is replaced in Colorado and Utah by *A. concolor*, and in Oregon by *A. grandis*. All the specimens sent from Colorado by Parry, Hall, and others belong here; but in Oregon collections it is mixed with *A. grandis*, and in both regions has been designated by this latter name. Its nearest affinity is not to any western *Abies*, but to the eastern *A. balsamea*, of which it may prove a geographical variety. Its leaves are shorter than those of *A. grandis*, those of the lower sterile branches are slightly emarginate, on the upper side grooved and without stomata. The leaves of vigorous shoots and of cone-bearing branchlets are acute, above convex and provided with stomata. The cones are purplish brown, the scales scarcely wider than long; the bracts are variable in this as in most other species, and not of much diagnostic value. Mr. A. Murray has, in an Oregon specimen collected by Dr. Lyall, noticed this difference of leaves of sterile and fertile branches, and therefore named it *A. bifolia;* this, however, is a misnomer, indicating something very different from what he intended, and cannot stand.

"In a paper shortly to be published in the Transactions of the St. Louis

Academy of Science, Dr. Engelmann has gone more extensively into the different questions relating to the North American species of Abies."

Until this very needful revision appears, the following characters, drawn from my own specimens, may serve to designate more particularly our welcome newcomer from the mountains.

Abies subalpina Eng., n. sp. Tall and slim, 80 to 100 feet high, often 50 feet without branches; bark smooth, white, and covered with vesicles to near the base; leaves 6 to 12 lines long, less than a line broad, not twisted near the base, bisulcate and somewhat glaucous on the lower (outer) side, short-pointed, obtuse or slightly emarginate, those on the lower branches 2-ranked and spreading, those on the upper scattered, crowded, and more or less appressed, shorter on fertile than on sterile branchlets; cones 2½ to 3 inches long, 1½ to 2 inches thick, solitary, erect, ovate or oblong, obtuse, greenish; scales 6 to 10 lines long and about as broad, horizontal and close-pressed, broad-cuneate, unguiculate, the rounded upper margin somewhat reflexed and resinous, pubescent; bracts short, white with a dark base, erose-dentate all round, their slightly elevated summits furnished with a strong mucro; seeds large, the wing covering nearly the whole surface of the scale; sterile aments 2 inches long, 3 lines in diameter, marked longitudinally and somewhat spirally by the dark centres of the otherwise light brown mucronate scales. — Lester F. Ward.

Botanical Papers in Recent Periodicals. — *Flora*, Nos. 16 and 17. J. Sachs, On Emulsion Figures, and Clustering of Swarm Spores in Water (continued in No. 17, and not yet finished). A. de Krempelhuber, Brazilian Lichens. Worthington Smith, The Resting Spores of Peronospora infestans. No other journals have come to hand at this date.

ZOÖLOGY.

Habits of the White-Footed Mouse. — The white-footed mouse (*Mus leucopus*) sometimes takes up its abode in deserted bird's-nests Audubon, in his work on the Quadrupeds of North America, speaks of this peculiar habit. He says it has been known to take possession of deserted bird's-nests, such as those of the cat-bird, red-winged starling, song-thrush, and red-eyed flycatcher. One day toward the end of August, 1875, I found one of these mice in the deserted nest of a red-eyed flycatcher (*Vireo olivaceus*); it was on the border of a thick forest in the Blueridge Mountains, Monroe County, Pa. The nest was situated near the extremity of one of the limbs of a sapling or young tree, a few feet from the ground. The mouse had completely stopped up the inside of the nest with dried grass, leaving just enough room to squeeze itself through, and have a comfortable bed at the bottom. It was inside of the nest when I found it, but afterwards escaped. When I first observed this peculiar structure I could not make out what it was; but on thrusting my finger through the dried grass, I discovered the strange tenant.

It moved off, after getting out of the nest, in a rather sluggish manner, as this species is nocturnal and sleeps during the day. — SPENCER TROTTER.

THE BLUEBIRD FEEDING ON AMPELOPSIS. — On the 2d of April, 1876, this city was visited by remarkably large numbers of the bluebird (*Sialia sialis* Baird). This was its first appearance in abundance this season, only a few stray individuals having previously paid us a "flying visit," during the wonderful installment of warm weather with which we were favored in January. The day was cold, and the frozen ground was partially covered with snow, the remains of the heavy fall of a few days before. Awakened before six o'clock in the morning by the loud twitterings of the birds, I found my visitors busily devouring the berries of the Virginian creeper (*Ampelopsis quinquefolia* Michx.), the vines of which extend over the whole of the easterly side of my house. They having been uncommonly prolific the past season, the branches were thickly covered with clusters of the purple fruit, which adhered to the stems all through the winter. From morning till night the bluebirds, continuing to arrive, crowded the vines, voraciously eating the berries, of which, in their eagerness, they broke off nearly as many as they swallowed. The next day the weather suddenly became milder, and the birds disappeared. — HENRY GILLMAN, Detroit, Mich.

ANTHROPOLOGY.

ANTHROPOLOGICAL NEWS. — In the third volume of the Transactions of the Academy of Sciences of St. Louis, Mr. A. J. Conant has published an article upon the archæology of Missouri, especially the caves of the Ozark Mountains and the mounds and earthworks on the banks of Bayou St. John, in the southeastern portion of the State.

The *New York Tribune* of July 7th records the tragic death of L. H. Cheney, a member of the Harvard Summer School of Geology, at Cumberland Gap. While excavating a mound with three others, he was buried by the falling earth. His companions were saved.

The State Archæological Association of Indiana will hold its first annual meeting in the rooms of the state geologist at Indianapolis, on the 17th and 18th of October. In addition to the regular sessions, excursions will be made to interesting localities. Provisions are also on foot to establish a museum and library. We heartily commend this scheme, and believe that exhaustive special collections are necessary to supplement the National and the Peabody Museums.

The *North American Review* for July contains Mr. Lewis H. Morgan's paper, read before the last meeting of the National Academy on the Houses of the Mound Builders. The distinguished author believes that the mural mounds were the foundations of the communal dwellings of village Indians, and that they can be understood by the study of similar structures now existing or known to have existed since the commencement of American exploration.

The Proceedings of the American Association for 1875 has appeared, and contains full reports or extended abstracts of C. V. Riley's paper on Locusts as Food for Man, Whittlesey's paper on Ancient Rock Inscriptions in Ohio, Morgan's paper on Ethnical Periods and on Arts of Subsistence, Sternberg's paper on Indian Burial Mounds and Shell-Heaps near Pensacola, Comstock's Archæological Notes from Wyoming, Coffinberry and Strong's paper on the Explorations of Ancient Mounds in the Vicinity of Grand Rapids, Michigan, Farquharson's paper on Recent Exploration of Mounds near Davenport, Iowa, and Gilman's paper on the Ancient Men of the Great Lakes. Several other papers are mentioned by title, but no abstracts are given.

The Society of Anthropology of Paris has offered a prize this year to be presented to the author of the best paper upon the subject, The Slavonic Races, and Maps of the Countries inhabited by the Slavonians.

The *Athenæum* for July 8th contains the remainder of the questions to be discussed at the International Congress of Orientalists at St. Petersburg. They relate to Turanian, Japanese, Indian, Arabian, Persian, and Hebrew investigations.

Professor Busk exhibited to the London Anthropological Institute, June 13th, a collection of skulls from the New Hebrides. Some of those from Mallicolo showed flattening of the forehead.

The first seven articles of the Transactions of the New Zealand Institute for 1875 relate to the Maori race, Moas and Moa-Hunters, and the relation between the Maoris and the Moa-Hunters. The tendency seems to be to discard the notions of Haast and others that the Moa became extinct many centuries ago, and that the Moa-Hunters were a prehistoric people, now quite extinct, and not at all related to the Maoris.

A paper by Mr. Rankin on The South Sea Islanders was read by Mr. Brabrook before the Anthropological Institute, June 13th, in which the title Mahori is proposed for the light-colored races of the Pacific Isles, and Papuan for the blacks. The author believes that the latter first peopled the greater part of the islands, and that the lighter race, coming later from the west, settled first in Samoa, and spread thence in all directions, mingling often with the Papuans. He showed several differences between the Maoris and the Malays, who seem to be a separate race.

In *Nature* for June 29th, the Rev. J. S. Whitmee makes some very sound observations upon the errors which have been propagated with reference to the supposed rapid decrease of the Polynesians, and the same may apply to aborigines in general. The first source of error is the excessively high estimates put upon these countries by early visitors, who assumed the thickly settled strips of coast which they explored as a sample of the whole country. In many islands, the author believes, the population is actually increasing, owing to the beneficial influence of the missionaries, the cessation of human sacrifice, cannibalism, and in-

fanticide, the fewer wars, the better treatment of women, the care of children, the sick, and the aged, and a more steady supply of food. Upon these topics the author has collected a great many statistics.

The second number of Broca's *Revue d'Anthropologie* for 1876 is at hand, and contains the following matter: Upon Cranio-Cerebral Topography, Broca; Banton or Abanton, Hovelacque; Vanikoro and its Inhabitants, Lesson; The Tumulus of Eshoj, Denmark, Engelhardt; Revue critique, Revue préhistorique, Revue des Livres, Revue des Journaux, Extraits et Analyses, Miscellanea, Nécrologie, Bulletin bibliographique. Nearly one half the number is taken up with the treatment of cranio-cerebral topography by M. Broca, and the review of the most eminent works which have been published upon the subject by Gratiolet, Arnold, Broca, Bischoff, Heftler, Turner, Féré, Ecker, and Landzert.

Das Ausland, under the editorship of F. von Hellwald, always contains some interesting anthropological description or discussion. In the number for May 29th is a review of Rutimeyer's Variation of the Fauna of Switzerland since the Existence of Man there, also a *résumé* of the Indian Tribes of the United States made from Authentic Sources, by Adolph Hunnius; in the number for June 5th, Dr. Bela Weisz discusses Œconomics; in that for June 12th, the Earliest Use of Potstone (Lapis ollaris), and in that for June 19th, the Origin of Alphabetic Writing, the Numerical Relations of the Sexes, and Manners and Customs in Servia are discussed. — O. T. Mason.

Occurrence of the Patoo-Patoo in North America. — An interesting example of the independent production of a well-known foreign form of weapons may be seen in the Michigan exhibit of stone and copper implements at the Philadelphia Exposition, where there is a single specimen of steatite patoo-patoo, such as is common in New Zealand. These weapons are described by Tylor (Early History of Mankind, p. 204, London, 1870) as "an edged club of bone or stone, which has been compared to a beaver's tail, or is still more like a soda-water bottle with the bulb flattened, and it is a very effective weapon in a hand-to-hand fight, being so sharp that a man's skull may be split at one blow with it." This description will strictly apply to the Michigan specimen, with the one exception of not being drilled at the smaller end, for a wrist cord. This weapon measures sixteen and one fourth inches in length. It is two and five eighths inches wide for eleven inches, when it tapers to one and one half inches, but again widens to two inches at the end, thus forming a terminal knob or button, about which a wrist cord could be securely fastened. The edges are beautifully wrought and are as sharp now as the general find of polished stone axes and celts. E. B. Tylor, whom we have already quoted, mentions the occurrence of such a specimen, "of dark brown jasper," from Peru, and also one, "of a greenish amphibolic stone," from Cuzco, which is figured by Rivero and Tschudi. Of the vast numbers of relics of American aborigines at Phil-

adelphia there is no other specimen of the form above described, and it is presumable that this weapon was one seldom fashioned in North America, and its occurrence seems better explained by considering it rather as an independent invention of its original owner, than a copy of the favorite arm of another people. — C. C. Abbott, M. D.

GEOLOGY AND PALÆONTOLOGY.

Icebergs off the Coast of Newfoundland. — On the coast of Newfoundland, icebergs generally make their appearance about the 1st of January. Their approach is heralded by a number of smaller pieces. When we reflect upon the origin of these bergs, it would appear that the greater number of them ought to be disengaged from their parent mass, the glacier, in summer-time. The semi-fluid mass of which the glacier is made up, creeping slowly, like a frozen river, down the valley, by the aid of heat, gravity, etc., has in summer-time its pace augmented by the increment it receives at this season of the year. It then pushes itself rapidly forward into the ocean, and there, by the buoyancy of the water, the projecting ice-mass is detached and floated off. Why, therefore, is it that the bergs are not seen off the coast of Newfoundland at the close of the summer, or at latest in the "fall" of the year? The answer to this may be obtained from the inference of Sir Edward Belcher and other arctic navigators, who tell us that in very high latitudes the ice appears to be in motion much earlier than it is farther to the south. On the 20th of May the western side of Smith's Sound has been found to be quite open for navigators in a boat, whilst Barron Strait is not navigable till late in August. The consequence of this would appear to be that whatever ice may be set free far north early in the year is detained in more southern latitudes until the fall. Another cause also operating in keeping the ice off the coast until the spring of the year may be the wind. Although icebergs, with regard to their motion and the direction of the wind, often present curious anomalies, yet these must to a slight degree be influential on their wanderings. In the fall of the year the prevalent winds on the North American side of the Atlantic are, generally speaking, from the west, which tend to keep all bergs out at sea, and thus to observers on the land they would be lost sight of; but in the spring of the year the winds are more or less northerly, which would only aid the current in bringing the ice along shore. The most apparent suggestion for the detention of the ice before reaching the shores of Labrador and Newfoundland is of course the distance it has to travel; but considering the steady rate at which this is carried on in the stream which bears it, the effects of wind and the delay in the breaking up of the southern arctic barrier must have the precedence. — *J. Milne in the Geological Magazine, July.*

Recent Views in Geology. — Mr. John Evans, in his late address as president of the Geological Society of London, after giving obituary

notices of Sir Charles Lyell, Mr. Scrope, Deshayes, and others, discusses recent phases of geological thought, and after speaking of the bearings of solar physics on the early history of our planet, refers to the glacial epoch, for the production of which he insists on a change in the geographical position of the earth's axis, and claims that it is premature to invoke intense glacial periods to account for all the glacial phenomena which may be observed. "Much as we must esteem the labors of M. Ahémar and Mr. Croll, and others who have gone so deeply into the question of glaciation, — enormous as have been the effects of ice in this and other countries, — there are many who cannot but feel that the ice-caps invoked almost transcend our powers of belief, and who will be grateful to any astronomer or mathematician who will bring the pole round which they were generated somewhat nearer to our doors."

He prophesies that "the great work of future palæontologists will rather lie in still further developing the affinities of genera, than in merely recording the minute distinctions of species. The discoveries which have of late been made have a tendency to fill in the missing links in the chain of organic nature, and to lead to the adoption of some form of that great doctrine of evolution which has received so large an amount of support from a former occupant of this chair, to whom we have this day presented the Wollaston Medal, Professor Huxley. It is highly probable that much more will be done in the same direction. In addition to what has been effected by Mons. Albert Gaudry in his researches on the fossils of Pikermi and Mont Léberon, and by Dr. W. Kowalevsky in his investigations of the osteology of the Hyopotamidæ, the discoveries of Professors Marsh and Leidy in America are doing much toward illustrating the line of descent of many of the higher mammalia."

A Carnivorous Reptile about the Size of a Lion. — Professor Owen describes and figures in the *Quarterly Journal of the Geological Society*, the remains of a carnivorous reptile from the Karoo Lake deposits of South Africa. It is called *Cynodraco major*, and for this type, with a number of other extinct carnivorous saurians, he forms a distinct order of reptiles under the name *Theriodontia*. In concluding his paper, Professor Owen inquires whether the transference of structures from the reptilian to the mammalian type has been "a seeming one, delusive, due to accidental coincidence in animal species independently (thaumatogenously) created, or was the transference real, consequent on nomogeny or the incoming of species by secondary law, the mode of operation of which we have still to learn? Certain it is that the lost reptilian structures dealt with in the present paper are now manifested by quadrupeds with a higher condition of cerebral, circulatory, respiratory and tegumentary systems, the acquisition of which is not intelligible to the writer on either the Lamarckian or the Darwinian hypothesis."

Geological Survey of Canada. — The Report of Progress for 1874–75, besides the introductory report by Mr. Selwyn, the director

of the survey, contains reports on the country west of lakes Manitoba and Winnipegosis, with notes on the geology of Lake Winnepeg, by Mr. Robert Bell; a report on the country between the Upper Assineboine River and lakes Winnipegosis and Manitoba, by Mr. J. W. Spencer; a report of much general interest on explorations in British Columbia, by Mr. James Richardson; and a report on geological observations in New Brunswick in 1874, by Prof. L. W. Bailey and Mr. G. F. Matthew. Other reports of economic interest follow. The staff of the director consists of ten geological explorers, and the total annual appropriation for this important survey is only $45,000, "a sum not greater than is granted for similar purposes by many single States in the neighboring Union."

The Walrus formerly in South Carolina. — In a collection of fossil bones from the Ashley phosphate beds near Charleston, S. C., Dr. Leidy identifies a complete tusk of the walrus, indicating a still farther point south for the extension of this animal than had been previously known, Virginia (at least Martha's Vineyard) having been, we believe, the farthest point southward where it had previously been found. Associated with this tusk were the skull of a manatee, a tooth of the Megatherium, and the bones of a number of new species of cetaceans, among them a huge tooth of a form allied to the sperm whale, and probably the same as those from the Crag formation of Antwerp, ascribed to Dinoziphius.

More Fossil Birds. — The bones of two species of a bird like the diver, and also with affinities to Professor Marsh's cretaceous genus *Hesperornis*, have been discovered by Professor Seeley in the chalk formation of England.

GEOGRAPHY AND EXPLORATION.

News from Stanley. — This enterprising explorer, after a long silence, during which much anxiety had been felt about him, writes from the district of Ujiji on Lake Tanganyika. The letters received and published in the *New York Herald*, are five in number, and contain a narrative of Stanley's voyages, land journeys, and adventures from June, 1875, when he was last heard from, to April 26, 1876, when he was within fifteen days' march of Ujiji. The first, written July 29, 1875, gives an account of his voyage from M'tesa's capital to his camp at the southern end of Victoria Lake, near the Shimeeyu River. He not only encountered violent and dangerous storms, but he and his party narrowly escaped massacre at the hands of the savage natives of Bumbireh, a large island on the western side of the lake. The second letter, written seventeen days later, describes his return, with his whole party, to Uganda (M'tesa's kingdom), and the punishment inflicted on the savages of Bumbireh by the way. An interval of five months elapsed before his third letter was written. During this period, by the friendly aid of

M'tesa, who furnished him with a large escort of Uganda spearmen, he crossed the country to the Albert Lake, traversing the lofty, mountainous region of Gambaragara, which was only seen by Speke in the distance. The latter estimated the altitude of the highest peak at ten thousand feet above the sea; but Stanley scaled the highlands dividing the two great lakes, and there discovered a new tribe of natives, of whom we only learn as yet that they are "pale-faced." This expression must not be taken too literally, yet the discovery is of very great interest in an ethnological point of view.

No dates are given of this journey, but Stanley appears to have reached the Albert Lake in December last. He encamped on a large bay or inlet, to which he gave the name of the Princess Beatrice, and after a short stay returned to Uganda without having made any navigation of the lake. This fact probably explains why M. Gessi, in April of this year, failed to obtain any news of Stanley's visit. The letter describing the journey was dated from Kawanga, near M'tesa's capital, on the 18th of January last. The next news is from Kanfurra, a point not yet located on the maps, March 26th. It is probably somewhere in the dominions of King Rumanika, who showed such favor to Speke and Grant, for Stanley speaks of having explored the Kageera River, a western tributary of the Victoria, the lake called Windermere by Speke, and the hot springs of Karagwe. The fifth and last letter was written on the 24th of April, in the now familiar region of Unyamwezi, and within easy reach of the little port of Ujiji, on Lake Tanganyika, where Stanley met Livingstone. His intention was to reach the northern extremity of the lake, and then cross to the southern end of the Albert Nyanza, thereby definitely settling another important geographical question. He was in good health, and still amply provided with men and supplies. — *New York Tribune.*

Circumnavigation of Lake Albert Nyanza. — At a late meeting of the Royal Geographical Society, a letter from General Stone, on The Circumnavigation of the Lake Albert Nyanza, by M. Gessi, was read. The points of importance in M. Gessi's paper were that Lake Albert Nyanza is one hundred and forty miles long and fifty broad, and that in the east there is a river flowing into the lake which is now confidently believed to be one of the sources of the Nile. This, Sir R. Alcock said, was a most important result of M. Gessi's expedition, as it made it quite clear that the White Nile issued from the Lake Albert Nyanza. Sir Samuel Baker had written to him (Sir. R. Alcock) indorsing the importance of M. Gessi's discoveries, which had established a fact that for eighteen centuries had baffled all the geographers of the world.

MICROSCOPY.[1]

Recognition of Wool in Mixed Fabrics. — Any child at all familiar with the instrument can instantly distinguish wool from cotton, linen, and silk, as figured in the common books on the microscope; but the exigencies of modern commerce have developed new and difficult questions in regard to the diagnosis of wool. The Treasury Department of the United States, after having from June, 1870, down to February, 1875, admitted certain fabrics, known as "calf-hair goods," free from those duties which would be levied upon goods composed in part of woolen fibres, on certificate from the manufacturers of such articles that they were made entirely of cow-hair, calf-hair, and vegetable fibres, and contained no wool or worsted in any form, became possessed of strong evidence that these fabrics were not made, and could not be made, wholly without wool, and submitted the question to the National Academy of Sciences for investigation, furnishing more than ninety samples of these goods as materials for study. Drs. J. J. Woodward and J. L. Leconte were appointed a commission to investigate the subject, and at their request Drs. J. G. Hunt and E. M. Schaeffer made a careful microscopical examination of the samples furnished, and also, for comparison, of different varieties of commercial wool and of hair from different animals, and prepared mounted samples of each for further study and comparison. The fibres, having been rendered opaque by the dyestuffs previously employed, were bleached in dilute mineral acids, mounted in glycerine, and examined mostly with powers of from $\frac{1}{2}$ to $\frac{1}{5}$ inch, except for estimating percentages, for which lower powers were employed. In a few of the samples submitted no wool was found, or only doubtful hairs, or a few fibres, not certainly indicating an intentional admixture. In a larger proportion of cases there was not much wool, while in a very large number of samples there was from five and ten per cent. to a much larger proportion; in one case it being difficult to find five per cent. of genuine cow-hair.

As a result of these observations, and of a subsequent verification of them, the commission submitted to the Secretary of the Treasury a report which contributes largely to the clearness of our knowledge of the relations of wool to other kinds of hair, and which is published, with excellent heliotype illustrations, in the Bulletin of the National Association of Wool Manufacturers, December, 1875.

While it is remembered that some microscopists deny the possibility of distinguishing the hair of the cow and calf from that of the sheep, and that others differ among themselves as to the result of observations on the same samples, and while it is admitted that both kinds of hair are of a very similar structure in respect to the arrangement and details of their medullary, cortical, and cuticular portions, it is still confidently asserted

[1] Conducted by Dr. R. H. Ward, Troy, N. Y.

that true wool can be reliably detected by the microscope in mixtures where it occurs. The kinds of hairs observed and described by the commission, may be conveniently arranged in three groups. First, wooly hairs. These mostly extend "from half an inch to several inches in length, without any medulla, and without perceptible taper. They present (especially in the wool of the sheep), at frequent but irregular intervals, well-marked, one-sided, more or less spirally arranged thickenings of the cortical substance, which gives to the wool its curly character. The mean diameter of each hair varies from $\frac{1}{500}$ to the $\frac{1}{1000}$ of an inch, or even less; and the scales of the cuticle are so arranged that their free edges project somewhat, forming well-marked imbrications, of which usually from fifteen to thirty can be counted in the $\frac{1}{1000}$ of an inch." Such hairs constitute the wool of commerce, originally limited to the sheep but now applied to the goat, camel, and llama, and similar hairs have long been known to be mixed with the straight hair of various animals, such as the "deer, hare, rabbit, beaver, otter, seal, lion, tiger, certain varieties of dog, and some foreign breeds of oxen." All these hairs are so much alike, structurally, that it is believed they should all be designated as wool, and it is not claimed that the animal from which they were derived can be uniformly and reliably determined by the microscope. Obviously some of these varieties not now recognized as wool might in the future become of sufficient commercial importance to require either the legalization of them all as "wool," or the discovery of more complete methods of discrimination. Second, straight hairs. These are often shorter, "much thicker at their base, and taper rapidly towards the point. The medulla occupies a large proportional part of the whole hair, and the free edges of the scales of the cuticle, which are so disposed as to form from twenty to forty imbrications to the $\frac{1}{1000}$ of an inch, lie quite smoothly upon the surface of the hairs, so that their contours, as seen under the microscope, closely approximate continuous lines. These characters are so well marked that the coarser hairs of the cow and calf can readily be distinguished from the woolly hairs of any of the wool-bearing animals." Naturally mixed with the wool of the sheep, however, especially with the inferior grades, and with that of the goat, forming the "outer coat" of the goat, are coarse, straight hairs, so closely resembling some of the hairs of the cow or calf that their discrimination presents great difficulties; and such hairs, even when derived from the wool-bearing animals, cannot be recognized as wool by the microscope. The percentage of "wool," therefore, as determined in mixed fabrics, by a microscopical count of hairs, would probably be underrated in a certain proportion of cases. In case all woolly hairs which are "more or less crispy, curled, or frizzled" should be legalized as wool, it would probably be convenient to make an exception, admitting as genuine wool such a percentage of straight hairs as is found to be present in a specified quality of the sheep's coat. Third, doubtful hairs. Among the imbricated hairs

of the wool of the sheep some are occasionally found which so closely resemble the softer hairs of the cow or calf that the investigators confess themselves unable to discriminate between them in all instances. Hairs of this description are therefore more properly classed as doubtful, than included in either of the other groups.

Animal and Vegetable Cellulose and Starch. — Mr. Thomas Taylor has contributed to a late Monthly Report of the Department of Agriculture some interesting experiments by which starch-like bodies are artificially produced. On a fibre of cotton is placed a drop of a strong, amber-colored tincture of iodine, followed by a drop of commercial muriatic acid, and immediately afterwards by a drop of concentrated sulphuric acid. The combination of the sulphuric acid with the water of the muriatic causes the liquid to boil for two or three seconds, and the cellulose or cotton fibre is changed, as shown under a power of about one hundred diameters, into the form of disks or beads of a well-defined blue color. A similar change can likewise be produced in flax, and in a variety of vegetable tissues. Fresh animal tissues yield a somewhat similar result, brain, heart, liver, muscles, etc., having been successfully experimented upon. Fibrine of blood, both human and bird's, dissolved in caustic potash and precipitated by acetic acid, gives well-characterized granules, a result which is confirmed by hundreds of experiments.

Arranged Pollens. — Mr. J. A. Langstroth has presented to the San Francisco Microscopical Society slides having pollen from different species of flowers, arranged on the same slide for convenience of comparative study.

Effect of Aperture on Definition. — Mr. J. Zentmayer, in a very clear lecture on the elementary properties of lenses, published in the *Journal of the Franklin Institute*, May and June, 1876, calls attention prominently to the confusion of images necessarily attendant upon large apertures, except when viewing absolutely flat objects, from the stereoscopic character of the images formed by different portions of the surface of the lens, the image formed by pencils transmitted by one side of the lens being unavoidably different from corresponding images formed by the opposite side of the lens.

Microscopical Examination of Crude Drugs. — Prof. M. W. Harrington, whose well-known success in this branch of study gives interest to any production for which he is responsible, being not yet ready to publish his work on the Identification of Vegetable Drugs, Foods, and Fibres, has caused the publication in pamphlet form (by John Moore, publisher, Ann Arbor, Mich.) of the Introduction and Analytical Tables with which the book will be furnished. The brief introductory part contains a few excellent general suggestions in regard to this kind of work, while the analytical tables are a novel and able application of the methods of the artificial keys of modern works on botany to this field of microscopical research. The tables are published now, and in this form,

partly for convenience in class use in teaching, and partly that they may, by the test of practical use, receive any necessary corrections or additions before the publication of the full work.

Aperture of Objectives. — Mr. F. H. Wenham's experiments with the slit as a means of cutting off the lateral rays of an objective have led him to announce the belief, in the *Monthly Microscopical Journal*, that an excessive or false aperture is attributed to all objectives by the lateral pencils which direct light far beyond the axial one, and thus greatly enlarge the diameter of the proper light disk. An aperture mapped out on a screen shows the false aperture faintly portrayed as an outer circle of light, while the true aperture, as obtained by the slit, gives a bright, oval disk within the other. As an example of the effect of the slit in reducing to what he regards as the true aperture, he mentions the following reduction of the nominal angles of three lenses made nearly twenty years ago: a $\frac{1}{5}$ of 100° to 56°, a $\frac{1}{8}$ of 130° to 92°, and a $\frac{1}{12}$ of 170° to 100°. He invites discussion upon this novel and very interesting question, which ought to excite the greatest attention until settled beyond dispute.

Mr. Wenham now uses a slit of fixed width, cut through an opaque film upon a glass slip 3x1, being substantially the method contrived by Mr. Tolles, and published in the Naturalist for March, 1875. He also adopts without credit Mr. Tolles' plan of covering the slit with a balsam-mounted thin cover-glass, so that the objective can be adjusted and tested under natural conditions.

Photographing the Nineteenth Band. — Count Castracane has photographed, apparently successfully, Nobert's nineteenth band, with an amplification of eight hundred diameters obtained by means of a Gundlach dry lens of $\frac{1}{13}$ German inch focus. The object was illuminated by an achromatic condenser of large angle, and with a large central stop. The resolution of this band of lines of $\frac{1}{112320}$ inch by a dry lens, has not been generally deemed possible heretofore. The genuineness of the photographic lines was established by micrometric measurement. This success, if reliable, seems an invasion of Helmholtz's theory on the ultimate limits of microscopic power; but such theories seldom live long.

Popular Microscopy. — The increasing use of the microscope among persons of previously unscientific habits and education is nowhere better shown than by the demand for what is called a popular method of treating the subject in books and journals. Mr. John Phin's little book on the Selection and Use of the Microscope, intended for beginners, in which the subject is simplified and rendered elementary to a greater extent than ever before in a really scientific work, was so well received as to lead, apparently, to the establishment of a periodical, the *American Journal of Microscopy*, a monthly magazine published in the same spirit and under the same management.

An Easy Nitzschia. — The No. 19 of Möller's test plate, resolved

into beads by the Nachet No. 5 objective of the San Francisco Microscopical Society, proves to be an anomalously easy shell. The objective fails on No. 19 of other slides by the same maker. Mr. Hyde is of the opinion that the resolved shell is a true *Nitzschia curvula*, although so exceptionally easy that it is resolved by any good $\frac{1}{5}$.

Collecting Diatoms. — Much of the difficulty of making reasonably clean collections of diatoms may be obviated by using Mr. John Redmayne's method, which is described in *Science-Gossip*. A wide-mouthed bottle is attached to a cane in the usual manner, but instead of being open it is closed by a tightly fitting cork, through which are passed two glass tubes, terminating near the bottom of the vial. Externally one of these tubes is slightly bent sideways, so that its outer end can be easily approximated to a deposit of diatoms at the bottom of the water, while the other tube is bent at right angles immediately above the cork, and joined to a flexible rubber tube, which extends up to the handle of the cane. By compressing the rubber tube against the cane with the thumb of one hand, the bottle can be readily brought empty into position, when the calibre of the tube is restored by removing the thumb, and the pressure of water forces air out and water in, carrying the desired objects with it. Should the water be too shallow to afford enough pressure, suction at the upper end of the flexible tube may be employed to exhaust the air, and thus secure a rush of water into the bottle, a glass tube or ball pipette serving as a mouthpiece.

If too muddy, the gathering may be further cleaned by placing it in a long bottle, the bottom of which is covered with black paper. Thus arranged, and placed in the sunlight, the diatoms will soon free themselves from the mud and rise to the surface of the water.

Micro-Photography. — Dr. Edward J. Gayers, of Calcutta, in his work at micro-photography takes his position near the microscope where it and the illuminating reflector can be manipulated with the greatest ease, while the image on the focusing screen is examined with a small telescope consisting of a large opera-glass objective and a microscopical ocular.

Water Analysis. — While there is still great doubt as to the exact influence or significance of forms perceptible by the microscope in drinking-water, there is no doubt a very general interest in studying and recognizing these forms. In such study good use may be made of Dr. J. D. Macdonald's work on Water Analysis, in which a large number of the more common forms of mineral and organic constituents are figured in rather crude but very suggestive and natural-looking pen-sketches, which are better as a means of recognition than the elaborate and flattering steel-engravings often used. Accompanying the drawings is a good synopsis of the subject in a few pages of print, which will be convenient even to those who have access to libraries of more elaborate works.

PRACTICAL HISTOLOGY. — A good hand-book for students in the histological laboratory is the little publication of Outlines, by Dr. Rutherford, first issued in a journal some years ago, and lately enlarged and improved in an interleaved edition for laboratory use.

SCIENTIFIC NEWS.

— Near Gilroy, California, is a rose-tree of the cloth-of-gold variety twelve years old, the stock of which is *seventeen* inches in circumference, and, though closely pruned, the branches spread five feet on every side of the trunk.

— In the museum of the California Academy of Sciences is a transverse section of a lemon verbena six inches in diameter. The wood is fine-grained, of a greenish-yellow color, and takes a good polish.

— Our readers may remember a statement by Professor Snow in the NATURALIST, ix. 665, to the effect that the female of the white pelican has a horny crest on the mandible as well as the male. Mr. George B. Sennett, of Erie, Pa., writes us that in two females shot in Grant Co., Minn., the crest was as perfect in proportion to the size of the bill as in the males.

— Mr. James T. Gardner, at present Secretary of the American Geographical Society, has been appointed director of a proposed Geographical Survey of the State of New York.

— A Monograph of the Phalænidæ or Geometrid Moths of the United States, by A. S. Packard, Jr., forms vol. x. of the final reports of the United States Geological Survey of the Territories, F. V. Hayden in charge. Although a formal notice of this work would for obvious reasons not be in place in this journal, the author would beg leave to call the attention of naturalists to matter contained in the introductory portion, especially to the chapters entitled Comparative Anatomy of the Head, Comparative Anatomy of the Thorax, Development of the Thorax of the Imago, Secondary Sexual Characters of the Imago, and to the essay on Geographical Distribution. The imagines of about four hundred species and the early stages of some are described and figured.

— Professor Huxley, who is now on a short visit to this country, will deliver three lectures in New York September 18th, 20th, and 22d, on the "Direct Evidence of Evolution," and also give an address at the opening of the Johns Hopkins University.

— It is well to signalize the close of a great work which has been in progress for twenty-five years, — the *Genera des Coléoptères* of Lacordaire and Chapuis. The work was first assigned to Lacordaire of Belgium and Carreño of Spain; Carreño, however, died before the plan of the project was definitely settled, and Lacordaire undertook it alone. The first volume was published in 1854. At the death of Lacordaire, in 1870, Chapuis took his place, and has now completed the work, which

consists of twelve volumes, two of them double, illustrated by one hundred and thirty-four plates. It treats of about six thousand genera; in the nine volumes by Lacordaire the species of each genus are enumerated; but Chapuis has considered this unnecessary since the appearance of Gemminger and Harold's Catalogue. Each volume has an index of its own, and the final volume (published in April), a systematic and alphabetical index to the whole, occupying over one hundred and fifty species.

—The Annals, published by the late Lyceum of Natural History for over half a century, will be continued under the name of Annals of the New York Academy of Sciences, by that Society. Contributions to its pages, and subscriptions, are respectfully solicited. The yearly subscription is two dollars, payable in advance. Communications may be addressed to Prof. D. S. Martin.

— We have from time to time drawn the attention of our readers to the zoölogical station founded by Dr. Dohrn at Naples. How useful this aquarium and laboratory combined has proved to zoölogists in Eu rope is shown by the very satisfactory first annual report, just issued. The large building is situated on the Villa Reale or royal park of Naples, a yard and a half below the level of the sea, on the sand-beach of the shore of the Bay of Naples. The lower story or basement is divided into two sections, containing a cistern room of seven hundred and four square yards, with conduit, engine, and pump rooms. Four four-inch pumps maintain a constant circulation in the large aquarium, and there are pumps for filling the smaller aquaria and for pumping in the sea water. The larger basin contains one hundred and twelve cubic yards (metres) of water. The room for the public is two hundred and sixty square yards in extent, and there is a large and thoroughly equipped laboratory, a library, rooms, with a large corps of assistants, including four fishermen, who are constantly collecting material. The station cost about $75,000, and the annual running expenses appear to be about $10,000. The report closes with an extended list of apparatus for laboratory work and a table showing the time of appearance of the different species of animals and their reproductive season, of much use to naturalists who may desire to know the particular date for the appearance of certain animals they want to study. The catalogue of those who have worked at the station includes forty-six names of European naturalists, no American among them. There is also a list of museums and universities to which choice collections have been sent.

— The geology and physical geography of Otago, a portion of New Zealand, is discussed in a report to the Provincial Council of Otago, by Messrs. Hutton and Ulrich. The volume is illustrated by a colored geological map and lithographic plates, and conveys a good idea of the scenic and geologic features of New Zealand.

PROCEEDINGS OF SOCIETIES.

ACADEMY OF NATURAL SCIENCES, Philadelphia. — May 9th. Dr. Leidy observed that the so-called phosphate beds of Ashley River, South Carolina, were remarkable for the irregular admixture of multitudes of fossils of different ages, from the early tertiary period inclusive down to the present epoch. The phosphatic nodules, for which the beds are explored, appear to have had their origin from the eocene rocks beneath. These have also contributed numerous remains of marine vertebrates, especially of Zeuglodonts, reptiles and fishes. Mingled in the sand and clay with the phosphatic nodules and bones of eocene animals are innumerable remains of cetaceans, sharks, and other marine animals of perhaps the middle and later tertiary ages. Added to these are multitudes of remains of both marine and terrestrial animals of the quaternary period. Mingled pell-mell are found bones of the eocene Zeuglodonts — animals related to the whales and seals; hosts of teeth of the great eocene shark, *Carcharodon angustidens;* myriads of the teeth of the giant sharks of the later tertiary periods, the *Carcharodon megalodon;* bones and teeth of whales and porpoises; abundance of remains of elephants, mastodons, Megatherium, horse, etc., and occasionally the rude implements of our own immediate ancestors.

From among a collection of fossils from the Ashley phosphate beds, recently submitted to his inspection by Mr. J. M. Gliddon, of the Pacific Guano Company, the specimens were selected which were presented for the examination of the meeting. One of them is a well-preserved tooth of a Megatherium; another, a characteristic portion of the skull of a manatee; a third, a complete tusk of the walrus, indicating a still further point south for the extension of this animal than had been previously known; a fourth, a huge tooth of a cetacean allied to the sperm whale, probably the same as those from the crag of Antwerp, ascribed to Dinoziphius. Besides these there are the beaks of three cetaceans of the little known family of the Ziphioids. These are porpoise-like animals, without teeth in the upper jaw, and usually with but a single pair of teeth in the lower jaw. The beaks composed of the coösified bones of the face are remarkable for their ivory-like density, which probably rendered them available as weapons of defense.

A fourth beak from the same locality, but from another source, belongs to a different species of the same family. These beaks and some associated fossils will form the subject of a paper shortly to be presented to the Academy. The species indicated by the specimens exhibited were described under the names *Choneziphius trachops, Choneziphius ciops, Eboroziphius cœlops,* and *Belemnoziphius prorops.*

Professor Leidy, in continuation, remarked that the remains of life, of any kind, were exceedingly rare in the mesozoic red shales which cross our State about fifteen miles north of us. Hence any fossils what

ever from these rocks were of interest. The three cycloid fish scales, and a few detached caudal rays, in the fragments of red shale presented by him this evening, he found on the Perkiomen Railroad, near Yerkes Station, Montgomery County. One of the scales resembles those described by the late Professor E. Emmons, under the name of *Rabdiolepis elegans*, from the mesozoic coal shales of Chatham County, N. C.

Mr. Redfield called the attention of the members to the volume of letters of Zaccheus Collins, belonging to the Academy, which had been recently arranged and bound by him. The volume contains an unbroken series of sixty letters, from Rev. Henry Muhlenberg, of Lancaster, to whom American botany has been so much indebted; also, a correspondence with his son, Fred. Aug. Muhlenberg, in which we find the history of the transfer of the Muhlenberg Herbarium to the American Philosophical Society.

There are also numerous letters from Stephen Elliot, Dr. Jacob Bigelow, Dr. William P. C. Barton, Dr. William Baldwin, Nuttall, Torrey, Leconte, Sr., and many others well known to the scientific world. It cannot be expected that these letters of sixty years ago can add any new botanical facts to our stock, but they have great interest as illustrating the early history of botanical science in our land, and as revealing to us the obstacles which the student of that day encountered in the scarcity of books and in the difficulty of communication.

Professor Frazer spoke of thinness or minuteness of objects under the microscopic and suggested method of studying, by means of the fluorescent ray, objects at present invisible to the highest powers.

Dr. Hunt stated in reply that microscopists were not willing to be limited in their observations by the calculations of mathematicians, and that the comparative darkness of the fluorescent ray would not be favorable to investigations of the kind.

In continuation Dr. Hunt spoke of the destruction of potato-starch by the fungus causing the potato-rot, and stated that he had observed, under the microscope, the absence of starch in the cells attacked by the Peronospora, although the fact of such invasion being productive of the result described had been denied.

Mr. Thomas Taylor, of the Department of Agriculture, spoke of the effect of frost upon potatoes, and stated that he had found starch at the end of twelve months in frozen tubers. He also observed that the potato fungus would grow in cells devoid of starch, but he had not observed the destruction of granules by the cause referred to.

May 16th. Mr. Thomas Meehan said that what was popularly known as the "sleep of plants," the closing of some kinds at night-fall, though a matter within common observation, had not, so far as he was aware, been made a subject of physiological investigation, with the view to ascertaining the value, if any, of this kind of motion in the economy of plant life. He had recently discovered that by means of this peculiar

motion the common *Claytonia Virginica* and some buttercups were fertilized by their own pollen. The fertilization of these plants had been somewhat of a mystery to him, as in view of some prevailing theories of cross fertilization by insect agency, these plants ought not to be self-fertilized, but from repeated observations he was satisfied that no insects had visited plants that had yet seeded abundantly. The process of fertilization in Claytonia and Ranunculus, independent of insect agency, was described minutely.

Plants of course had peculiar functions to perform, and there were pre-ordained plans and special arrangements through which these functions are exercised. But the workings of plant life are so complicated that though we see certain results follow certain movements, we are not always sure that we perceive the great and deeper object arrived at in the order of nature. Hence arose the differences of opinion prevailing in regard to the object of cross fertilization. Some plants had arrangements which seemed to preclude the possibility of self-fertilization, and the assumption followed that nature abhorred close breeding in plants and specially designed such structures to secure the plant against it. He believed that nature had a deeper purpose, as yet unknown, and chiefly because of such instances as he had given this evening, where nature could not abhor close breeding, when the result of the "sleep of plants" was most perfect in securing self-fertilization.

May 23d. Dr. Leidy observed, in continuation of his remarks of the previous meeting, on the extinct animals of the Ashley phosphate beds of South Carolina, that they are remarkable for the multitude of remains of fishes which they contain, especially of sharks and rays. Among the former were the giants of their kind, the *Carcharodon megalodon* and *C. angustidens*. A tooth exhibited of the megalodon shark is five and a half inches long and four and a quarter inches broad at the base. The living white shark, pertaining to the same genus, reaches upward of thirty-five feet in length, and has teeth two inches in length. Supposing the megalodon shark to have reached the same proportions in relation with the size of the fossil teeth, it must have exceeded seventy feet in length, and must have proved the most formidable monster of the ancient ocean.

Another specimen presented for the inspection of the members is a knob of bone, such as is found at the root of the tail of the devil-fish, the largest of the existing rays. In the latter the bone is the only one of the body, and it supports a minute spine, a mere rudiment of the barbed weapon of the sting-ray. Our devil-fish, of which a specimen was once exhibited in Peale's Museum, of this city, reaches a breadth of eighteen feet, with a length of about fifteen feet. The fossil bone, though the only thing left to tell the tale of its former possessor, is quite a characteristic specimen. It is of more robust proportions than that of its living representative, and probably indicates an extinct species, for which the name *Ceratiptera unios* was proposed.

Specimens exhibited of the dental armature of the roof and floor of the mouth of eagle rays were referred to extinct species under the names *Myliobates majester* and *M. mordax*, the former having been one of the largest of its kind. Similar specimens from the eocene marl beds of Monmouth and Burlington counties, N. J., were referred to species with the names of *Myliobates fastigiatus* and *M. jugosus*.

Professor Leidy further directed attention to a specimen of the snout of an extinct cetacean, which he had recently observed among some fossils from the Ashley beds in the Smithsonian collection of the government department of the Centennial Exposition, and which had been obligingly loaned to him for description by Mr. W. P. Blake. The specimen, two and a half feet in length, had the density of ivory, and indicated one of the largest of the little-known family of the ziphioid whales. It was referred to a new genus and species, with the name of *Proroziphius macrops*.

The other fossils are of the giant sloth, the Megatherium, presented by Mr. George T. Lewis, of this city. These were also found in the Ashley deposits, and are probably the remains of animals which became mixed in marshes after the elevation of the Ashley deposits above the ocean level.

June 6th. Professor Cope spoke of the structure of the foot in certain eocene unguiculate mammals. The name Creodonta was proposed for the group. The peculiarities of eocene forms, allied to the lemurs, were described, and other groups were defined under the names Mesodonta, Insectivora, Tillodonta, and Tæniodonta. These were collectively placed under the head of Bunotheria.

Mr. Meehan remarked on the subject of cross fertilization of plants and fertilization by insect agency.

June 13th. At the recent meeting of the Academy, Professor Cope called attention to certain fossil remains from the Rocky Mountains. The physical peculiarities of the region in which they were found were described. Among the specimens were fragments of limb bones indicating an animal of considerable size, which was probably allied to Labyrinthodon or some other huge batrachian. The name *Dystrophæus viæmalæ* was proposed for the form indicated, which is particularly interesting as being the first vertebrate found in the trias of the Rocky Mountains.

June 25th. The members of the Botanical Section reported the holding of a meeting for organization and the election of the following officers: —

Director, Dr. W. S. W. Ruschenberger; vice-director, Thos. Meehan; conservator, C. F. Parker; recorder, Isaac Burk; treasurer, Jose O. Schimmel; secretary, Dr. Leffman.

Dr. Leidy again called attention to the remains of fossil whales from the Ashley River deposits and exhibited another specimen from the Cen-

tennial Exposition, for which the name *Proroziphius conops* was proposed. A fragment of a skull of Squalodon from the same collection was also exhibited. The remarkable admixture of fossils of different geological ages in these deposits was again alluded to.

A tooth of a Megalodon shark, measuring six and seven tenths inches long, was described, and the opinion advanced that, comparing it with teeth of existing sharks, it probably had belonged to an individual upwards of one hundred feet in length.

Professor Cope recorded having seen remains of a cretaceous vertebrate from the deposit spoken of by Dr. Leidy. It belonged to the sixth genus of the order Pythonomorpha and was described under the name of *Cyclotomodon vagrans.*

Professor Cope also exhibited and described a fossil fish from the cretaceous formation of Nebraska. The structure of the mouth was that of the soft-rayed fishes, and the other characters ally it to the group to which belong the mullets. The dentition and the structure of the caudal fin were described and the name *Anogmius aratus* was proposed for the form.

California Academy of Sciences, San Francisco. — April 3d, Professor Davidson read the first of his series of papers on irrigation, harbors, and engineering in Europe and Asia, giving the results of personal observation. The paper was devoted to Indian irrigation, and was rich in interesting details, and in the value of its conclusions applied to the necessities of artificial water-courses in California. The lecturer said that the Indian canals had not paid private capital, and the expense had been assumed by the government, which is projecting and building a magnificent system of irrigating works.

Dr. Hale, a visitor, related an instance of "mimicry" which he observed in the Santa Cruz Mountains. It was a milk-white spider, in shape, size, and color the exact counterpart of the flower Medrono.

April 18th. Captain Bryant, United States Treasury Agent, who is stationed on the Aleutian Fur Seal Islands, was present, and gave a brief history of the habits of the seals and the manner in which they are caught. Notwithstanding the slaughter of one hundred thousand annually by the Alaska Commercial Company, the legal limit under the company's lease from the national government, a careful calculation shows that the seals are increasing, as compared between the year 1869 and the past season, five per cent. in number. The revenue of the government from this source is $325,000 per annum, being nearly five per cent. on the amount paid for the territory of Alaska.

Boston Society of Natural History. — June 7th. Communications were read by Dr. W. K. Brooks on The Separation of the Sexes in Salpa by means of Natural Selection; by Professor A. Hyatt on Old Age among the Ammonites of the Oölitic Formations; and by Mr. W. O. Crosby on the Geology of Eastern Massachusetts.

New York Academy of Sciences. — April 17th. Mr. George F. Kunz read a note on the Phosphorescence of Pectolite, as distinguishing it from the Zeolites. One of the members exhibited a series of Graptolites from the shales of Norman's Kill.

In a paper on the Causes of the Cold of the Ice Period, Dr. Newberry reviewed, from a geologist's standpoint, the theories proposed to account for the cold of the ice period. He said these theories formed two categories: one, the cosmical; the other, the terrestrial.

In the first, the Glacial Period is attributed to astronomical causes, such as variation in the eccentricity of the earth's orbit, in the angle of the axis of the earth with the ecliptic, or in the quantity of heat received from the sun, the passage of the earth through cold spaces in the universe, etc. The discussion of these theories he left to the astronomer and mathematician.

The terrestrial theories considered were those of Lyell and Dana, in which the cold of the Glacial Period is ascribed to a peculiar distribution of land and water, the land being supposed to be high, broad, and continuous in the arctic regions, forming great condensers of atmospheric moisture, and barriers excluding the tropical currents from the arctic sea; and the theory of Professor Henry, which ascribes the great extension of glaciers in the polar regions to a large amount of moisture thrown into the air in the tropics by volcanic agency. Both these theories, however plausible, are based on conjecture only, and are not supported but are opposed by known facts.

For example, in the Tertiary Period the climate over the arctic regions was as mild as that of our Middle and Southern States. A luxuriant forest covered arctic America, — Greenland, Iceland, etc., — in which were the tulip-tree, magnolias, deciduous cypress, and other plants now growing in the United States. At this time the land was broad, for there are almost no marine Tertiary deposits in the arctic regions, and there was land connection between America and Asia, and between America and Europe, forming barriers which must have excluded tropical ocean currents from the polar sea. On the other hand, the land of the tropical regions in Tertiary times was low, for we find marine Tertiaries bordering or covering the continents and islands.

There is no evidence that the arctic lands were high and broad in the Ice Period, but during at least a portion of this period, Greenland, England, and Scandinavia were much lower than now. At the same time the tropical lands were apparently near their present level.

The objections to the volcanic theory are that we have no evidence of unusual volcanic action in the tropics during the Quaternary age, and it is not certain that the production of a great amount of vapor there would produce glaciers in the arctic regions, as, when ascending to the height of a few thousand feet, the vapor would be locally precipitated. The transfer of heat and moisture from the tropics to the poles is chiefly through oceanic and not through atmospheric currents.

For the reasons given, the terrestrial theories were regarded as inadequate, and the conviction was expressed that we must look to some astronomical cause for an explanation of the phenomena of the Ice Period.

May 15th. Mr. I. C. Russell read a paper on the Ancient Glaciers of New Zealand, and Mr. A. A. Julien remarked on the Search for Flint Implements in the Valley of the Saone.

May 29th. The following papers were read: On Determinations of Specific Gravity by the Arabians of the Twelfth Century, by Dr. H. C. Bolton; Notice of Recent Investigations as to a Change of the Earth's Axis at the Close of the Tertiary, by Professor B. N. Martin.

SCIENTIFIC SERIALS.[1]

American Journal of Science and Arts. — August. Note on the Development and Homologies of the Anterior Brain-Mass with Sharks and Skates, by B. G. Wilder. The Greenstones of New Hampshire and their Organic Remains, by G. W. Hawes.

The Geological Magazine. — July. The Carrara Marbles, by G. A. Lebour. Distant Transport of Volcanic Dust, by A. E. Nordenskiöld. On the Mechanics of Glaciers, by D. Burns. Ice and Ice-work in Newfoundland, by J. Milne.

The Geographical Magazine. — July. Statistics of Danish Greenland. The Voyage of the Challenger, by J. E. Davis. The Andaman Islands, by F. A. de Röepstorff. A Journey into the Arabian Desert of Egypt, by Drs. Schweinfurth and Güssfeldt. Verrazzano, by R. H. Major.

Jenaische Zeitschrift für Naturwissenschaft. — April 15th, Ueber Ontogenie und Phylogenie der Insekten, von Paul Mayer.

Annals and Magazine of Natural History. — July. On the Affinities of the Anthozoa Tabulata, by G. Lindstroöm. *Eozoön Canadense* according to Hahn, by J. W. Dawson.

Monthly Microscopical Journal. — July. On the Rotifer Conochilus volvox, by Henry Davis. On the Abbé Count Castracane's Photographs of Nobert's Nineteenth Band, by H. C. Sorby. On the Aperture of Object Glasses, by F. H. Wenham. On the Limits of the Optical Capacity of the Microscope, by Professor Helmholtz, with a Preface by Dr. H. Tripp.

[1] The articles enumerated under this head will be for the most part selected.